# JOURNAL

OF THE

# NEW YORK

# ENTOMOLOGICAL SOCIETY

Devoted to Entomology in General



Volume XXXI, 1923

NEW YORK
PUBLISHED BY THE SOCIETY
QUARTERLY
1923

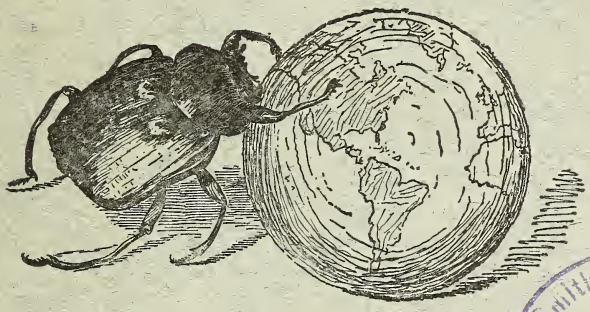
LANCASTER PRESS INC.
LANCASTER, PA.

# CONTENTS OF VOLUME XXXI.

Vol. XXXI. March, 1923 No. 1

# JOURNAL OF THE New York Entomological Society

Devoted to Entomology in General





MARCH, 1923

Edited by HOWARD NOTMAN



Published Quarterly by the Society.

LANCASTER, PA. NEW YORK CITY

1923

(Entered April 21, 1904, at Lancaster, Pa., as second-class matter under Act of Congress of July 16, 1894.)

THE NEW ERA PRINT

## CONTENTS



NOTICE:—Volume XXX, Number 4 of the Journal of the New York Entomological Society was published on February 9th, 1923.

JOURNAL

OF THE

New York Entomological Society.

Vol. XXXI. March, 1923. No. 1

# NOTES ON NORTH AMERICAN CICADAS WITH DESCRIPTIONS OF NEW SPECIES.

By Wm. T. Davis,

Staten Island, N. Y.

In 1906 Distant's catalogue of the Cicadidæ of the world appeared, and it has since been an invaluable guide with reference to the literature of our North American species. The writer has, however, suggested on several occasions that some of the names appearing as synonyms really represented valid species, as for instance in this Journal for March, 1915, where the seven names listed under *Rihana grossa* were stated to represent five species. Most of these names had been proposed by Francis Walker in 1850 and 1858, and fortunately many of his types are carefully preserved in the British Museum.

In 1920 Prof. Z. P. Metcalf, of North Carolina, sent specimens to Mr. Distant, who compared them with Walker's types. In 1921 Mr. James P. Chapin kindly carried several specimens to the British Museum that were compared for me by Mr. K. G. Blair of that institution. In 1922 Dr. Joseph Bequaert took a still larger number of specimens to the British Museum, and spent some time in making comparisons. To all of these gentlemen I am very greatly obliged for the aid they have rendered. The result of their findings is recorded on the following pages, and it will be noted that no change in nomenclature is necessary except in the case of *Cicada sayi* Smith and Grossbeck (1907), which should hereafter be known as *Tibicen chloromera* (Walker), 1850.

**Tettigonia grossa** Fabricius (1775).

This species was considered in this JOURNAL for March, 1915, p. 2, and the conclusion reached that *grossa* was probably not a native of the United States, and that our large species of the eastern states should be called *auletes* Germar.

Dr. Bequaert reports: "The type is in the Banks Collection; is a male from 'Brazil.' The shape of the opercula is slightly different from that of *auletes*. Length of fore wing 53 mm."

The following four species, namely *sonora, literata, resonans* and *figurata,* were proposed by Walker, and later the names were placed as synonyms of *grossa* and *auletes* by Distant in 1906. The last two were restored to specific rank in this JOURNAL for March, 1915.

**Cicada sonora** Walker (1850).

Dr. Bequaert reports: "The type is a male without locality label, but with a number referring to an old register where the locality is given as 'N. Holland.' The pruinosity of the abdomen has apparently been completely rubbed off, but there is certainly none on the middle segments. The opercula have the size and shape of those of *auletes*. The color markings are similar, though the yellowish is more extended on the mesonotum than in *auletes*. Length of fore wing 59 mm."

**Fidicina literata** Walker (1850).

Dr. Bequaert reports concerning this insect: "The type is a male without locality. Upon comparison this proves to be identical with *auletes* in size and shape of opercula, in the extension of pruinosity (absent on the middle segments), in the shape and size of the wings. Length of fore wing 58 mm."

**Tibicen resonans** (Walker).

*Cicada resonans* Walker (1850).

A figure of this insect was published in this JOURNAL for March, 1915.

In 1920 Prof. Metcalf sent a North Carolina specimen, which I have seen, to Mr. Distant, and received a reply that it was "identical" with Walker's type.

In 1922 Dr. Bequaert compared a specimen from Mississippi, and reported as follows: "The type is a female without locality. I have

compared it with your specimen of *resonans* and found the two identical. Length of fore wing 53 mm."

**Tibicen figurata** (Walker).

*Fidicina figurata* Walker (1858).

A figure of this insect was published in this JOURNAL for March, 1916.

In 1921 Mr. Blair stated: "The specimen sent agrees best with *figurata* in distribution of the black markings (though they are a little more extensive and confluent) and in some of the wing veins being black, but the basal membranes of fore wings are brighter yellow."

In 1922 Dr. Bequaert wrote: "The type is a female without locality. Compared with your specimen it agrees perfectly; having narrow wings (length of fore wing 48 mm., greatest width of fore wing 14 mm.); blackish basal cell; orange membranes at the base of the wing; pruinosity over all segments; the markings too are very much alike."

**Thopha varia** Walker (1850).

Placed as a synonym of *dorsata* Say by Distant (1906).

Dr. Bequaert's memorandum on this specimen is as follows: "The type is a male without locality. It agrees with your specimen of *dorsata* Say, having especially the short and broad wings (fore wing 45 mm. long, 18 mm. greatest width). The markings and especially the pruinose spots of the abdomen are the same."

**Fidicina crassa** Walker (1858).

This was considered a synonym of *dorsata* Say by Distant 1906, and Dr. Bequaert was requested to compare the type with specimens of *dorsata* and *dealbata* Davis. His findings are as follows: "The type is a male without locality. It agrees also with *dorsata* Say (length of wing 43 mm.; width of wing 18 mm.)."

**Tibicen chloromera** (Walker).

*Thopha chloromera* Walker (1850).

*Cicada sayi* Smith and Grossbeck (1907).

*Chloromera* was placed as a synonym of *Rhina tibicen* Linn. by Distant (1906), but as this last-mentioned species was described from Madame Merian's figure of a Surinam or South American insect, as

shown by Smith and Grossbeck, Entomological News, April, 1907, and as no native insect has been found to fit the figure, it is concluded that it is not a North American species.

The original description of *chloromera* is in part as follows: "Body black above, tawny and tinged with green beneath: head a little narrower than the fore-chest, adorned with several small tawny marks, and on each side of the front with one of larger size; face slightly convex, not at all prominent, adorned with a pale tawny elliptical mark, tawny with blackish bands on each side in front: mouth tawny with a pitchy tip, reaching the middle lips: eyes rather prominent: scutcheon of the fore-chest adorned with two oblique black stripes, which are united behind; fore-border black excepting a little interval in the middle; hind-scutcheon [posterior margin of pronotum] adorned on each side with three greenish tawny spots, one large, the other two small; sides not angular, but slightly excavated in front and slightly convex near the base of each fore-wing: scutcheon of the middle-chest adorned with a tawny slender double U-shaped mark whose inner sides are interrupted in front and behind, on each side of this are two oblique tawny stripes which are united behind; the middle pair are broader than the other pair, and their inner sides are excavated; hind border slightly excavated in the middle; cross-ridge tawny: abdomen obconical, longer than the chest, black above, tawny beneath: drums very large, pale tawny, much more than half the length of the abdomen, slightly overlapping . . . wings colourless, bright green at the base; veins ferruginous, green towards the base and along half the length of the fore border; first and second cross-veins clouded with brown. Length of the body 17 lines; of the wings [expanse] 48 lines."

This description seemed to cover *sayi* so well, particularly the statement concerning the long opercula, that Dr. Bequaert was requested to try and find Walker's type and compare with a male and female *sayi* sent for that purpose. His report is as follows: "The type is a male with a label 'T. W. Harris, N. America.' It has large opercula; no black stripe on the under side of the abdomen; the wing is evenly bent on the outer margin; the uncus is shaped as in *sayi;* the markings of the thorax are much the same. I should regard this as *sayi* S. & G."

**Tibicen azteca** (Kirkaldy) 1909.
*Cicada pallida* Distant (1881), preoccupied.

A figure of this insect was published in this JOURNAL for December, 1917. Dr. Bequaert compared a male from Oklahoma with the type, and reported as follows: "The type is a male without locality label. It agrees exactly with your specimen, especially in the shape of the opercula. There are in the British Museum collection next to the type of *pallida,* two males and one female of this species, from 'Texas, Belfrage.'"

**Tibicen olympusa** (Walker).
*Fidicina olympusa* Walker (1850).
*Cicada milvus* Walker (1858).

*Cicada sordidata* Uhler (1892) was placed as a synonym of *Cicada viridifascia* by Distant (1906), but was instead considered a synonym of *olympusa* in this JOURNAL for March, 1916, p. 59, and the insect was figured. In 1921 a male from Florida, the type locality, and known to be *olympusa,* was compared by Mr. Blair, and he reported as follows: "The specimen sent agrees well with both above types [*olympusa* and *milvus*] except that black markings of both pro- and mesothorax are more intense and more extended (in the types the lateral marks on mesothorax are more shadowy and distinctly smaller than the median pair). In the types the basal half of costa is distinctly greenish without black vein, as indeed are all the veins except towards the apex of the wing."

**Tibicen viridifascia** (Walker).
*Cicada viridifascia* Walker (1850).
*Cicada reperta* Uhler (1892).

*Cicada viridifascia* Walker was so identified from Florida by Mr. E. P. Van Duzee in the Bulletin of the Buffalo Society of Natural History, 1909, p. 184, and in this JOURNAL for March, 1916, p. 60, the writer suggested that *Cicada reperta* Uhler (1892) was a synonym. In 1920 Prof. Z. P. Metcalf sent to Mr. Distant a specimen from North Carolina known to be *reperta,* which Mr. Distant stated was "identical" with *viridifascia.*

**Okanagana occidentalis** (Walker).
*Cicada occidentalis* Walker (1866).

In 1921 a female of what was thought to be *occidentalis* from

Wallace, Idaho, and two female *bella* from Utah, were compared by Mr. Blair with specimens of *occidentalis* in the British Museum. He reported as follows: "I am unable to find the type specimen, which should bear the reg. no. 64.18, but there are 6 other specimens collected by J. K. Lord, one of which bears the name *occidentalis* in Walker's handwriting. These may be regarded as cotypes, and place the identity of the species beyond question. They agree well with the specimen sent with this name. They are placed by Distant, both in the collection and in his catalogue, as synonymous with *O. rimosa* Say, but I believe that two, if not three, species have been here confused; *O. occidentalis* being distinguished by the clear, or nearly clear, basal cell, the narrow orange posterior border of the pronotum not extending up the sides, etc."

In 1922 Dr. Bequaert was given a female *occidentalis* from Wallace, Idaho, a female *bella* from Stockton, Utah, and a male *rimosa* from Cumberland, Maine, for comparison. He reported as follows: "The true type is lost, but another female with a label '*occidentalis*' in Walker's writing has been selected by Distant as cotype. It has the last ventral segment twice notched as in your *occidentalis.*"

With the specimens handed to Dr. Bequaert for comparison were cicadas related to those about which information was sought and they received due consideration. They were *pruinosa, linnei, lyricen* and *similaris;* also *marginalis, resh* and *dealbata.*

**Tibicen pruinosa** (Say). Variety. Pl. II, Fig. 1.

In the summer and fall of 1921 Miss Louise Knobel of Hope, Arkansas, sent me 236 males and 243 females of this species. It is remarkable that more females than males were collected. Under date of August 25, 1921, she wrote that *pruinosa* was present in great numbers and sang in the late afternoon. On September 15 she wrote: "Maybe you don't know that Mr. Pruinosa is Hope's greatest nuisance this season . . . the chorus is very loud from about 3 till 7 P.M. . . . nearly all I have sent you were taken in town from our shade trees at all hours of the day, but mostly from 3 till 7 P.M. while singing." In 1922 Miss Knobel heard the first *pruinosa* on June 12, singing about midday. At Hallowell, Kansas, Dr. R. H. Beamer heard the first one singing on June 25. Mr. A. E. Brower has collected them on several ocasions in October at Willard, Missouri, and

Miss Anna Bennett collected a male at Hydro, Oklahoma, in October, 1915.

Among the great number of specimens sent by Miss Knobel there was a remarkably colored individual which is figured on the accompanying plate. It is a female and has a dorsal line of silvery pruinose spots on the abdomen, one on each segment. This is interesting because several species of cicadas, as for instance *dorsata, dealbata* and *bifidus,* regularly have a dorsal line of spots on the abdomen, and *marginalis* occasionally has. In *pruinosa* such a condition seems to be of great rarity, and shows an interesting tendency of maculation. In *linnei, figurata* and *similaris,* there is occasionally in fresh specimens an inconspicuous dorsal line of golden pubescence on the abdomen.

**Tibicen robinsoniana** Davis.

This species was described from Virginia in the March, 1922, number of this JOURNAL. Recently two males have been found in my collection from Hollister, Missouri, collected by Dr. Harry H. Knight, July 22, 1915. This considerably extends the known range of the species. Dr. Knight at the time wrote me that these particular specimens had a peculiar song, stating: "The one labeled *z-z-zip* is a species that I found among black-jack and other scrub oaks on the flint ridges."

* * *

In Biologia Centrali-Americana, Distant described *Cicada hilaris* and *Cicada intermedia,*[1] both from "Mexico"; the description of *intermedia* is very brief. The writer has had for some time several specimens of a cicada marked "*intermedia?*" and recently Dr. Paul B. Lawson of the University of Kansas sent an additional specimen. This last was photographed both above and below, and the pictures sent to the British Museum. Mr. W. E. China kindly compared these with the type of *intermedia,* and reports that my specimen appears to be distinct, "by the greater width of the head, larger size and in the color markings and pilosity. *Intermedia* has two white pilose spots on the inner margins of the tympana, and a white pilose band at the base of the first abdominal segment on either side. There is no white

[1] Both of these names had been previously used when Distant described these cicadas in 1881, and were therefore preoccupied.

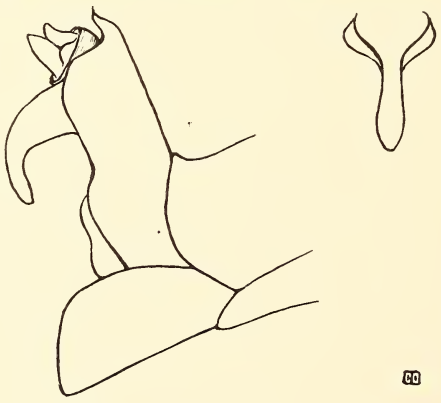
edge to the mesonotum as indicated in the photograph, nor are there two light spots on the anterior margin of the mesonotum." The basal cells of the tegmina are ochraceous in *intermedia* "with a dark spot anteriorly towards the apex of the cell. The opercula are of the same shape and size in both specimens. *Intermedia* has the basal cross vein of the second and third apical cells suffused with piceous." It expands 57 mm.

From *Cicada hilaris,* as described and figured in Bio. Cent.-Am., the specimens under consideration differ in having a proportionately broader head (broader than the base of the pronotum) and in being larger. Also the basal margin of the eighth abdominal segment (called sixth in description) is creamy white as stated both in the text and shown on the plate. *Hilaris* expands 52 mm.

From the above we conclude that the following species is distinct.

**Tibicen chiricahua** new species. Pl. I, Figs. 1, 2, and 3.

Head across eyes broader than the posterior width of the pronotum; front moderately produced; no median sulcus, transverse rugæ well defined. Many white hairs on the face, the remainder of the under side of the body with but few hairs except on the legs. The opercula are broadly rounded at extremities and overlap; the last ventral segment is not truncated, but is rounded and feebly notched at the extremity. Uncus bent as shown in the illustration, and not forked at the extremity. Sides of the body conspicuously parallel for a considerable distance, more so than in *townsendi, bifidus,* or *duryi,* which it somewhat resembles. The tip of the abdomen of the female gradually tapers about as in *duryi;* is more drawn out than in some other species that have the last few segments rather suddenly constricted.



TIBICEN CHIRICAHUA

Body above black; head with an orange spot at base and apex of front, one on each lateral and two on posterior margin. Pronotum with large dull testaceous spots centrally; lateral and posterior margins black edged with orange, also an orange line on the front margin for about the length between the eyes; the orange is broadest on the sides near rounded posterior angles. Mesonotum with two curved orange colored lines centrally extending backward from the front margin about half way to the cruciform elevation, and in the allotype, as well as in some of the paratypes, there is a silvery, pruinose spot bordering outwardly, each of the curved lines near its anterior extremity. Outer margin of mesonotum and near the base of both pair of wings also pruinose. The cruciform elevation is orange, black centrally, with a black band crossing each of the anterior limbs. Abdomen black above with a rather large dull orange spot centrally and a pruinose silvery spot at the inner anterior margin of each tympanum. Also, silvery pruinose each side on segment three, and slightly on the other segments to eight which is slightly pruinose on its posterior two thirds, the basal third being black. There is also a feeble orange spot each side on segment eight. In the allotype the posterior margin of segment eight is pale. Underside of body salmon colored, particularly the opercula and central part of the abdomen, otherwise variegated with black about the face, legs, and along the sides, the ventral part of the abdomen being almost entirely pale in some specimens. Fore wings with the basal area dark, lighter near the inner margin, surrounding veins orange or orange and black; venation darker about marginal cells; first and second cross veins clouded. The basal membranes of both pair of wings are grayish tinged with orange.

MEASUREMENTS IN MILLIMETERS.

| | Male Type. | Female Allotype. |
|---|---|---|
| Length of body | 28 | 22 |
| Width of head across eyes | 9.5 | 8.25 |
| Expanse of fore wings | 71 | 60 |
| Greatest width of fore wing | 11.5 | 10.5 |
| Greatest width of operculum | 6 | |
| Greatest length of operculum | 7.5 | |

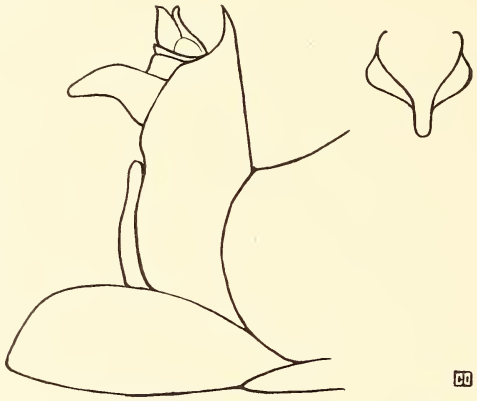
Type male, Pinery Canyon, Chiricahua Mts., altitude 6,000 ft., Cochise Co., Arizona, June 12, 1919, and allotype female from same locality, June 25, 1919 (Witmer Stone). Collection Academy Natural Sciences, Philadelphia.

In addition to the type and allotype the following specimens have been examined: Pinery Canyon, Chiricahua Mts., Arizona, June 30, 1919, female (A. Wetmore), expands 62 mm.; Nogales, Arizona, August, male (Oslar), expands 69 mm.; Magdalena, New Mex., male (Strickler), expands 73 mm., and in collection of the University of Kansas.

The following species resembles *Tibicen chiricahua,* but is much larger, and has differently shaped opercula and uncus. Only the type is known.

**Tibicen parallela** new species. Pl. I, Figs. 4 and 5.

Head across eyes broader than the posterior width of the pronotum; front moderately produced, no median sulcus; transverse rugæ well defined. Many white hairs about the face, also numerous hairs on the under side of the abdomen, more than in *chiricahua.* The opercula overlapping at base with extremities rounded, but not as broadly so as in *chiricahua;* they are more spreading toward the tips and in shape resemble those of *townsendi.* Last ventral segment broad at the extremity and with a shallow, open notch. Uncus as in the illustration, broad at the base and with the apical part not as slender and curved as in *chiricahua.* Sides of the body noticeably parallel, about as in *chiricahua.*



TIBICEN PARALLELA

Body above black, with a rusty appearance, owing to being sparsely covered with scattered, short, pale hairs, that are particularly abundant about the cruciform elevation, and on the abdominal segments. Head with an orange spot at base and apex of front, otherwise black above. Pronotum black. Mesonotum with two curved orange colored lines centrally extending backward from the front margin about half way to the cruciform elevation. Outer margin of mesonotum, and near base of both pair of wings, orange. The cruciform elevation is black, fore limbs orange, each crossed by a black band. Abdomen black above with a small pruinose spot each side at the base of segment three; also segments three to eight inclusive with a dull orange spot each side at the posterior angle. Under side of body pale, pruinose on each side of the abdomen, also about the base of the legs. Fore wings with the basal area clouded about as in *townsendi,* and not as darkly so as in *chiricahua;* the first and second cross veins hardly clouded; the venation in both pairs of wings brownish, costal margin paler. Membranes at the base of the fore wings are bright orange, more so than in any related species except *duryi,* where they are reddish in color. The anal vein bordering this orange membrane

anteriorly is broad and dark colored, showing conspicuously in contrast. The basal membrane of hind wings is not quite as highly colored.

MEASUREMENTS IN MILLIMETERS.

| | Male Type. |
|---|---|
| Length of body | 32 |
| Width of head across eyes | 12 |
| Expanse of fore wings | 87 |
| Greatest width of fore wing | 12.5 |
| Greatest width of operculum | 6 |
| Greatest length of operculum | 7.5 |

Type male, Albuquerque, New Mexico, August 20, 1911 (Oslar). Davis collection.

**Tibicen knighti** Davis.

This species was described and figured in this JOURNAL for December, 1917, from five males collected in Sabino Canyon of the Santa Catalina Mountains, Arizona, altitude 6,500 to 7,000 feet. A further note on its habits appeared in the March, 1921, number. In 1921, Mr. Edward P. Van Duzee collected eight specimens of this species while on a trip along the shore of the Gulf of California, and kindly sent them to me for examination. The records are as follows: San Pedro Bay, Sonora, Mex., July 7, 1921, 2 males; San Carlos Bay, 3 males and 2 females, July 8, and one male, July 9, 1921. The specimens were fresh and the dorsal surface, except where rubbed off, quite generally covered with short, soft, silvery colored prostrate hairs. The last ventral segment of the female is not broadly notched with a second notch within, as in *castanea,* but quite the reverse; it is singly notched, and on each side of the notch the margin of the segment is produced into points. It is really within the area of this projection that the notch occurs.

Mr. Van Duzee wrote of this insect: "The larger species from San Carlos Bay had a louder chirp or song which sounded farther away than it really was, but was not difficult to locate, and the insect did not seem at all timid; I think I took all I heard."

**Pacarina puella** new name. Plate II, Figs. 3 and 4.

In Mr. Van Duzee's Catalogue of the Hemiptera of America North of Mexico (1917), *Pacarina signifera* (Walker) is recorded from Texas and Central America. The species was described by Francis Walker in 1858 as *Cicada signifera* from Orizaba, Mexico. Lately

in looking over a copy of Germar in Thon, Ento. Archiv., ii, 2, p. 7 (1830), the name *Cicada signifera* was noticed. On page 144 of Distant's Catalogue of 1906 he credits the species described by Germar to South Africa, and places it in the genus *Psilotympana* Stål (1861). On page 8 of Germar's paper of 1830 he describes a second *Cicada signifera* giving the locality as Brazil. Later in Silb. Rev. Ent., ii, p. 63 (1834), Germar changed the name of this second *signifera* to *Cicada stigmatica* (see Distant's Catalogue, 1906, p. 134).

From the above it is evident that in 1858 when Walker described his *Cicada signifera* two other cicadas had already received that name from Germar and one of the names was in good standing. It would therefore appear that Walker's *signifera* should receive a new name, and *Pacarina puella* is here proposed.[1] It is a surprise that Kirkaldy did not bestow one in his article on "Hemiptera Old and New," Canadian Entomologist, 41, p. 391, 1909, when he changed a number of preoccupied names of cicadas. Among our North American cicadas that have received new names for the reason mentioned are *Cicada marginata* Say, 1825, changed by Walker to *Cicada marginalis*, 1852, and *Cicada pallida* Distant, 1881, changed by Kirkaldy to *Cicada azteca*, 1909. The name *calliope* Walker, 1850, now placed in the genus *Melampsalta*, has taken the place of *parvula* Say, 1825, and *pallescens* Germar, 1830, for the reason that both of these names were preoccupied at the time they were proposed.

A Guatemalan specimen of this species is figured under the name of *Proarna signifera* by Distant in Biol. Centr.-Amer., Rhynch. Hom., t. ii., fig. 21. In the writer's collection there are two males and a female labeled Monterey, Mexico, July, 1899, received from Prof. E. D. Ball. In the eastern half of Texas the species appears to be rather common. Specimens have been examined from Brownsville, Victoria, Floresville, Gillette, Rio Frio, Sabinal, Hondo, San Antonio, Anhalt, Southerland Springs, New Braunfels, Kerrville, Baby Head and Chillicothe. The dates of capture for the Texas specimens are in May, June and July. In the U. S. National Museum there is a male labeled Alexandria, La., Aug. 12, 1910 (H. Pinkun). As far as the writer is aware this is the first published record for Louisiana.

[1] This change is supported by the ruling in Entomological Code, by Banks and Caudell, where it is stated: "In case of primary homonyms the later name shall be changed, no matter to what genus they are now referred."

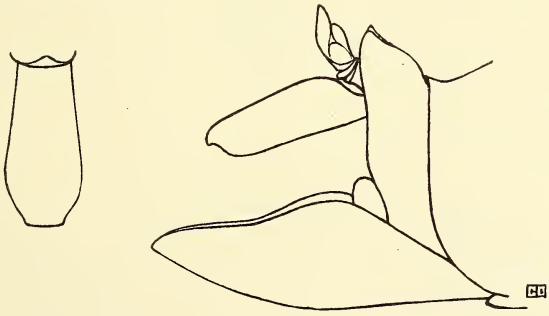
The insect also probably occurs in Oklahoma, as Chillicothe, Hardeman County, Texas, is near the border line.

In the Annals and Magazine of Natural History (8), vol. 8, p. 134 (1911), Distant states that the species was "only previously known from Central America. The Geneva Museum possesses a series of specimens taken at Dallas, Texas. Some of these agree with the typical form, others have the spots on the mesonotum nearly confluent, thus giving it an almost black appearance. Others, apparently bleached specimens, have nearly all of the macular markings obliterated, including those on the tegmina."

**Okanagana nigrodorsata** new species. Pl. II, Fig. 2.

Resembles both *occidentalis* and *bella,* but is almost wholly dull black on the dorsal surface of the body, except for some small inconspicuous spots on the front of the head and at the base of the wings. It is not as shining as in *occidentalis,* nor blue-black and shining as in *bella.* It also may be separated by the elongate-shaped uncus, which is figured. From *ornata* it differs greatly in color, and in the shape of the last ventral segment both in the male and female.

Head rather small and not quite as broad as the front margin of the pronotum; front moderately produced, about as in *bella,* and more so than in *occidentalis;* median sulcus well defined. Pronotum with the humeral angles rounded; the anterior angles prominent and slightly rounded. Sides of the pronotum usually with a few irregular sinuations. Last ventral segment with the sides curved inward to the extremity which is somewhat truncate, rounded at the sides or outer angles.



OKANAGANA NIGRODORSATA

Uncus when viewed in profile not hooked at the extremity and much slimmer in proportion to its length than in either *occidentalis* or *bella;* when viewed from behind, with a shallow notch at extremity. Last ventral segment of the allotype doubly notched. Fore and hind wings with the costa pale

orange to the end of the radial cell, darker beyond. Venation of both fore and hind wings dark in color; basal cell almost black. Membranes at base of all wings orange variegated with black, especially on the hind wings. The wings are of the broad type, as in *occidentalis* and *bella,* and not of the narrower form, as in *rimosa.*[1] Head black except the supra-antennal plates, and narrow, interrupted, transverse stripe in front of the anterior ocellus, which are pale. Pronotum black. Mesonotum and metanotum black except a small orange spot at the base of each wing. Tergum black. Uncus black; valve black, edged above with pale, also a pale spot on under side. Abdomen black beneath, each segment edged on the posterior margin with orange. Legs contrastingly variegated with orange and black; upper side of femora and about one half of each tibia black, then almost wholly orange to end of legs, except claws, which are darkened.

MEASUREMENTS IN MILLIMETERS.

| | Male Type. | Female Allotype. |
|---|---|---|
| Length of body | 24 | 23 |
| Width of head across eyes | 7 | 6.25 |
| Expanse of fore wings | 60 | 61 |
| Length of valve | 5 | |

Type male, Mt. Hough, Plumas Co., Calif., 7,000 ft., June 19, 1918 (Frank Morton Jones). Davis collection.

Allotype female, near Davis Creek, Modoc Co., Calif., July, 1922 (Dr. A. W. Lindsey). Davis collection.

The following paratypes have been examined: Webber Lake, Calif., July 23, two females (O. Sacken); Tuolumne Co., Calif., two females (no date label), also male with no locality or date label, collection U. S. Nat. Museum. Angora Lake, Tahoe, Calif., July 11, 1915, three males (E. P. Van Duzee), collection Calif. Academy of Sciences. Onion Valley, Calif., "8, 9, 13," male (H. E. Burke), and Tuolumne River, Sierra Nevadas, Calif., elevation 8,000 ft., July 11, 1922 (Victor Duran), writer's collection.

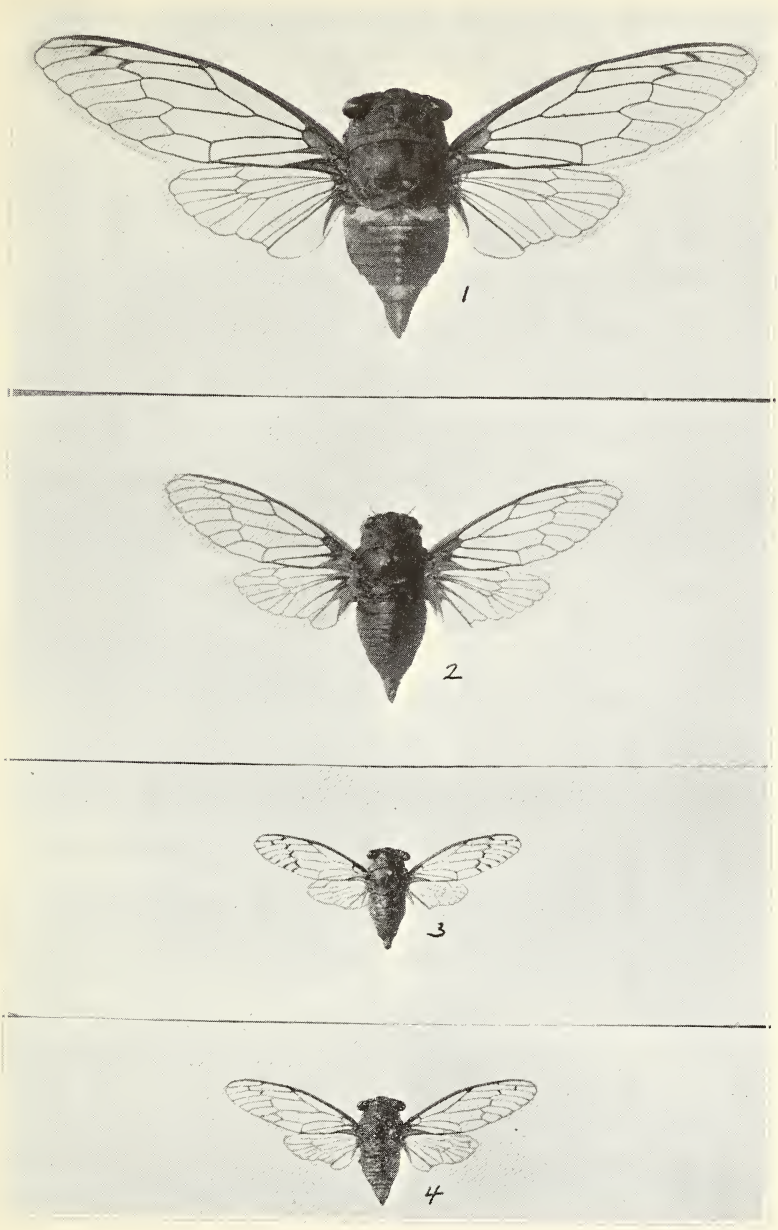
**Okanagodes gracilis** Davis.

This curious insect, with a protruding front and a narrow pronotum, was described and figured in this JOURNAL for June–September, 1919, and later a note on its discovery by Mr. Morgan Hebard at Bagdad, San Bernardino, Calif., in August, 1919, appeared in the March, 1921, number.

Mr. Edward P. Van Duzee has sent me six specimens for examination that have been placed at least for the time being under this name, for ultimately they may prove to be a second species of *Okanagodes.* They show slight structural differences, they are generally

[1] See JOURNAL, N. Y. Ento. Soc., Vol. XXVII, pl. XX.


CICADIDAE




CICADIDAE

smaller and much darker in color than specimens from Utah, Arizona and California. They were collected as follows: Smith's Island, Angles Bay, Gulf of Calif., June 27, 1921, male (J. C. Chamberlin); Angel de la Guardia Island, Pond Island Bay, Gulf of Calif., June 30, 1921, female, and July 1, 1921, three males and one female (E. P. Van Duzee). Mr. Van Duzee writes: "The small species from Pond Island Bay was taken on weeds and grass or even on the stones, on a rocky hillside a few feet above the floor of the valley; they have a short, sharp chirp like a house cricket only fainter, which was audible about 75 feet."

EXPLANATION OF PLATES I AND II.

PLATE I.

FIG. 1. *Tibicen chiricahua.* Type.
FIG. 2. *Tibicen chiricahua.* Allotype.
FIG. 3. *Tibicen chiricahua.* Enlarged.
FIG. 4. *Tibicen parallela.* Type.
FIG. 5. *Tibicen parallela.* Enlarged.

PLATE II.

FIG. 1. *Tibicen pruinosa.* Variety.
FIG. 2. *Okanagana nigrodorsata.* Type.
FIG. 3. *Pacarina puella.* Male from Gillette, Texas.
FIG. 4. *Pacarina puella.* Female from Victoria, Texas.

## THE LIFE HISTORY OF CHIRONOMUS CRISTATUS FABR. WITH DESCRIPTIONS OF THE SPECIES.[1]

BY HAZEL ELISABETH BRANCH, PH. D.

WICHITA, KAN.

### INTRODUCTION.

The study of the life cycle of this midge, the larva of which lives in waters charged with milk waste, is an outgrowth of a study in stream pollution that was conducted at Cornell University in 1920–21, the main results of which will be published elsewhere.

In the fall of 1919, Dr. P. W. Claassen of the department of Biology, Cornell University, found bloodworms growing profusely in

[1] A contribution from the Limnological Laboratories of Cornell University, Ithaca, N. Y.

a stream into which a milk plant at Adams Center, N. Y., poured its waste. These bloodworms upon being reared proved to be *Chironomus cristatus* Fabr. As the early stages of this species were undescribed, it was deemed necessary to study its life history and habits. This portion of the work was allotted to the writer, whose observations herein recorded were carried on through a period of one year.

The adults of this species are recorded by Johannsen from the states of New York, Illinois, Washington, Kansas, Idaho, South Dakota and New Jersey; and since it grows in waters of such common contamination it seems peculiar that the early stages have hitherto escaped notice. The larvæ grow readily in waters charged with milk and no difficulty has been experienced in obtaining heavy cultures and having them thrive and maintain themselves in such a medium both indoors and out.

In the indoor experiments, white enamelled steel pans of various sizes were used and in these, water was put to a depth of not less than ¾ of an inch and soil was added to cover the bottom. These pans were then stocked with either egg masses or young midge larvæ. Milk in a known proportion to the volume of water in the pan was added to these pans daily; thus the dilution for the best growing conditions was determined. The water was not changed but sufficient fresh water was added each day to maintain the original volume. By these means the conditions of a semi-stagnant pool were simulated. By screening the pans, several generations of bloodworms were raised in the same pan.

In the outdoor experiments, a sluice of about 125 feet by 3 feet and also a series of three ponds fed by pipes from this sluice were constructed. This sluice and the ponds having been artificially stocked from Adams Center, received milk waste daily. Other forms naturally found their way into these artificial breeding places but *Chironomus cristatus* Fabr. easily maintained itself as the dominant form present. It is the observations that were made under these controlled conditions that are here recorded.

## LIFE HISTORY.

*Eggs:* The egg masses of *Chironomus cristatus* are to be found at the surface of the water attached to stones, stumps, or vegetation projecting above the surface (Plate III, Figs. 2 and 5). These egg masses

occur in the greatest abundance at points in the stream just above the pollution and where the water ripples over stones and other material. The water movement in such places probably aids aëration and lessens the silt deposits upon the gelatinous envelope of the egg mass. The newly hatched larvæ cannot dispose of as great a percentage of waste per water volume as can the grown larvæ but they require more oxygen. In the ponds and in the breeding pans where no such ripples are available, the egg masses are placed at the edges rather than upon blocks and stones placed in the open water partly submerged.

The egg mass presents a color of light brown due entirely to the eggs, for the gelatine is colorless. The shape of the mass is that of a curved and tapering cylinder. The curvature is more noticeable if the mass be floating freely and moored only by its suspensory stalk (Plate III, Figs. 1 and 3; Plate V, Fig. 30). Frequently, however, the mass comes in contact with something in the water and lies straight. The masses vary in size and measure all the way from 5 to 10 mm. in length and 1 to 2 mm. in width at the middle. The eggs are imbedded in a gelatinous ribbon in which they are set obliquely to the axis of the ribbon and this ribbon is laid back and forth, transversely, to form a hollow cylinder. As the ribbon turns on the inner and shorter edge of the cylinder, the eggs of every other row lie parallel and the adjoining rows face in opposite directions. There are approximately 34 rows of 20 eggs each in a mass, the last 2 to 4 rows being in a spiral to close the cylinder. The mass is suspended by a slender gelatinous thread, which appears like a stalk, with an attachment disc upon its outer end. This disc is not visible unless the stalk fails to adhere to some support and in this case the disc flattens and remains in the surface film and the mass floats freely in the water. Usually the egg mass is just below the surface film which it buoys up slightly above the common level. When the mass is at rest, the attachment thread or stalk is scarcely perceptible, being not more than 0.5 mm. in length; a very short distance after it enters the mass it divides into two equal strands and these traverse the length of the hollow cylinder twisting upon each other rope fashion regularly at every other row of eggs. These strands adhere to each other and to the mass at the smaller end of the cylinder (Plate V, Fig. 30). The attachment thread with its two strands and the egg mass itself are extremely

elastic and while the egg mass itself may elongate to two or three times its original length, the stalk or single thread may stretch to 50 mm. or one hundred times its normal length. When the egg mass is released from the current or whatever has caused this elasticity to show itself, the stalk, strands and mass regain their former length and position. This may be a lotic adaptation protecting the mass from dislodgment by the current. If seized it may the more easily slip out of the mouth of a devourer. There are about 525 eggs in a mass on an average based on a count of 28 egg masses (782, 735, 672, 480, 408, 374, 396, 600, 612, 720, 442, 836, 660, 680, 364, 338, 260, 384, 324, 442, 330, 1440, 378, 255, 306, 440, 510, 544); all of which were hatched and reared and proved to be *Chironomus cristatus*. The eggs measure approximately 0.28 to 0.315 mm. by 0.13125 to 0.14 mm. They taper more toward the anterior end than the posterior end, while one side is slightly flattened (Plate V, Fig. 31).

*Egg laying:* The female in oviposition places herself against the support chosen and balances herself by means of her middle legs and her wings which she extends and moves from time to time. The front legs are held out forward as is their natural position while the hind legs are brought under the body with the distal ends of the tibiæ almost together. The tarsi lie at a little more than a 45 degree angle with the tibiæ with the most distal segment just barely touching the surface of the water. The abdomen is curved under with the tip below the thorax and almost touching the distal ends of the tibiæ. The stalk of the egg mass appears first. It does not adhere to any support as yet but lies between the tibiæ. When this stalk has been protruded about 0.5 mm. the ribbon of eggs appears and its end is attached to the stalk and then is swayed backward and forward around the twisting strands of the stalk to form the hollow cylinder described above. The abdomen can be seen to move from side to side as the ribbon is extruded and placed in position and the tip pulsates at the extrusion of each egg. When the ribbon is nearing completion the female moves the abdomen spirally for a few turns and closes the cylinder. The attachment stalk lies between the tibiæ just barely touching them, and the tarsi support the egg mass, the outer curve of which is therefore toward them. When the mass is completed, the female rests for a moment, draws the abdomen back into normal position, lifts

her body with a movement of the wings and jerks the tarsi from under the mass and flies off. The mass usually falls so that the attachment stalk meets the support upon which the female placed herself and the mass hangs just touching the water with the surface film drawn up over it. Frequently, however, the egg mass is entirely submerged. The entire process of egg laying, from the time the female selects the place and begins balancing herself until she jerks the tarsi from under the mass, occupies about 10 minutes. The mass is very dark and small when laid upon the tarsi but when in the water it expands to twice or three times its size when extruded.

*Development:* In these eggs, as the chorion is very transparent, much of the embryological development may be observed. The germ cells appear at the lower pole of the egg before it is two hours old. This was first observed by Robin, 1862, and further observed by Weismann, 1865, Balbiana, 1885, and Ritter, 1890. It is the classic evidence for Weismann's theory of the continuity of the germ plasm. The incubation period is short requiring only 2 to 5 days depending directly upon the temperature. An average of eleven cases where the egg laying was observed, and exact time therefore ascertainable, was three days. This covers a period from April 22 to August 7 with a range of temperature of the water from 62 to 78 degrees Fahrenheit. When the embryo is almost mature it is spirally arranged in the compass of the egg to accommodate its increasing length, with its head toward the tapering end. When completely mature the head still retains this position but the tail is no longer in the posterior end for the body has folded upon itself and the caudal end of the embryo lies in the center. The small red eye spots, a pair on each side of the head, and the four anal gills, the caudal prominences with their six hairs each, as well as the anterior and posterior prolegs are clearly discernible.

*Hatching:* When the time for the breaking of the chorion is at hand, the larva moves its head up and down as far as it can reach along one side of the narrow end of the egg until a slit is made and the head crowds its way out. The larva gradually unfolds itself by pushing with its anal feet against the side of the shell opposite the slit and by pulling the body along with its anterior prolegs. The process of breaking the shell is long and the larva frequently makes several

attempts of ten to fifteen minutes duration for several (4 to 6) hours. After the shell is broken the larva may crawl out at once or it may take 15 to 20 minutes to get itself entirely free. The empty egg remains in the gelatinous matrix of the mass which disintegrates after several days. The process of hatching usually begins at the attachment end of the mass and often 24 hours may be consumed in the hatching of a mass. 99 per cent. of the eggs of a mass hatch and even in cases where the gelatinous matrix for some reason disintegrates before hatching time, the greater majority of the eggs come to maturity and hatch into strong larvæ.

*Larval Life.*

*First Instar:* At hatching, the larva is very crumpled and the lines of segmentation are confused with wrinkles. The head capsule, from the posterior margin of the dorsal line to the tip of the labrum, is from 0.1225 to 0.1575 mm. and the entire length of the larva is approximately 0.56 mm. Within the hour the larva increases in length to about 0.635 mm. and when one day old measures 1.085 mm. or almost twice its length at hatching. As a head capsule does not change its size except at moulting, we may take this constancy and the change in size as indicative of moult in determining the instars. The teeth of the labial border are more pointed in this first instar than in the later instars (Plate IV, Fig. 10). The anal gills are four in number, the ventral gills are absent. The caudal prominences possess 6 hairs each and the anterior prolegs are clothed with fine curved hairs whereas the posterior ones are fitted with many bifid claws. The color of an individual is creamy and more or less transparent and it is only when a mass of several hundred is seen that a faintly pinkish cast may be detected. For the first day after hatching the larvæ remain upon the old egg mass crawling in and out of the hollow cylinder. Upon the second day they leave the mass and by their characteristic figure-of-eight movement swim about in the water. They collect in masses upon the lighter side of objects in the breeding pans or in the streams and ponds. When three or four days old each one builds a tiny little tube by drawing together soft refuse or small particles of soil and fastening them to each other and to some support by means of a silken substance which is secreted by the larva. These tubes which may not be a millimeter in length serve as habitations and within them an

observer may see the larva undulating its body so as to cause a current of water to pass through the tube which is open at both ends. The current of water bears particles of food which adhere to the silken lining of the tube and these particles are later eaten off by the larva. Frequently a larva reverses its position so as to cause a current of water to pass through the tube in the opposite direction.

The amount of food or volume of waste per volume of water consumed in this instar is small: a thousand larvæ will not take care of more than 0.1 c.c. or 2 drops, in 300 c.c. of water each day. They will, however, thrive in this medium and keep the water clear and odorless. Out of doors the larvæ of this instar are most usually found around the edges of stones or floating particles or vegetation and along the sides of the streams or ponds.

The first instar continues over a range of 4 to 8 days with an average in 21 cases of 5.5 days. This varies with the temperature but around 65 degrees Fahrenheit it is normal to look for the moult about the eighth day. When ready to moult this first instar larva measures approximately 1.575 mm.

*Second Instar:* With the first moulting the ventral gills appear. They are situated upon the next to the last segment of the abdomen and are four in number, a pair at either end of the segment. They are short and stubby being no longer than the posterior prolegs. The remainder of the body is as in the first instar only larger. The head capsule measures 0.21 to 0.245 mm. The labial border still has very pointed teeth but the median tooth instead of projecting beyond the second laterals as in the first instar has come to be on a level with them and the laterals beyond the second are less lanceolate. The color of the individual has become a pinkish brown with a color in the mass of a light red. They are still attracted to the light and collect upon the brighter side of the breeding pans hanging there for hours at a time. Their tubes are longer, the old one having been merely extended, and are still transparent enough for the larva to be seen within. In this instar the food percentage may be raised to 0.2 c.c. per 300 c.c. of water for a thousand larvæ. In the outdoor experiments, the larvæ are found in deeper water and further down upon the stones and vegetation. This second instar has a duration of four to ten days with a normal of seven days. The age of the larvæ varies

from 8 to 18 days with an average of 12 days in 11 cases. Normally we look for the second moult when the larvæ are about 15 days old. When ready for its second moult the larva measures at least 3.28 mm.

*Third Instar:* With the second moult, the ventral gills become longer in proportion to the body, being almost twice as long as the posterior prolegs and curving slightly toward them (Plate IV, Fig. 18). The head capsule measures from 0.42 to 0.45 mm. and the color has become noticeably red. The labial border has its median tooth shorter than the second laterals but is still pointed. The second laterals are becoming more rounded and the laterals beyond the seconds are normal in shape (Plate IV, Fig. 8). The larvæ are no longer attracted to light but remain in the tubes during the day. If surprised with a bright light at night they may be seen wandering about away from their tubes. During the day they may be seen in their tubes making their undulating movements and eating the food particles from the silken lining. The tubes are built closely together even when there is plenty of room in the pan, which is contrary to the condition in the first two instars when the tubes are built far from one another. Their habits are therefore almost reversed in respect to their attraction to light and the position of the tubes. The food percentage may now be raised to 0.5 c.c. per 300 c.c. for one thousand larvæ and this is the best growing medium for a mixed lot of larvæ of all ages. The larvæ of this instar seek the bottom. The instar has a duration range of 11 to 18 days and the age of the larvæ varies from 19 to 36 days with an average of 28 days for 11 cases. We usually look for the change about the 22d day. When ready to make this moult, the larva had attained a length of approximately 5.6 mm.

*Fourth Instar:* In this fourth and last larval instar the individual becomes a bright red with the head almost black. The ventral gills are long and coiled upon themselves, extending backward beyond the posterior prolegs. The head capsule varies from 0.70 to 0.77 mm. and the labial border has taken on the form shown in Plate IV, Fig. 7; the second and third laterals becoming very closely applied to each other. The duration of this stage is extremely variable and at present the controlling factors are unknown. Larvæ from the same egg mass vary from 4 to 23 days, and we have a range for the beginning of pupation from 19 to 64 days after hatching with an average of 27.6

days in 23 cases. Pupation may normally be looked for when the larvæ are about five weeks old. The food content of the water should be about the same as in the third instar but they can stand a higher percentage for a few days and still keep the water clear and odorless. The variation in the length of the life of the larvæ is of economic importance for although the crests of pupation may take place at regular intervals, one may find larvæ in all stages at any one time.

*Pupal Period:* The transformation to pupa usually takes place in the tube but frequently one may see the full grown larvæ, which measure from 14 to 16 mm. in length, swimming about out of the tube and transforming while free from any support. The second and third thoracic segments are brown and swollen and the respiratory filaments of the pupa as well as the compound eyes may be easily seen through the larval covering of the thorax. This condition may prevail for a day or two and then the larva breaks open upon the back of the thorax and the pupa wriggles out, usually not completely extricating itself from the larval skin which covers the posterior part of the pupa (Plate V, Fig. 27). When first transformed the pupa is a bright red with very black eyes and the respiratory filaments extremely white. It remains this brilliant spectacle for about one day and then gradually turns dark and the filaments become gray. Sometimes the pupa transforms to an adult while still in a larval tube but this occurs only when the water is low. The pupa lies upon its side upon the bottom, moving only slightly for two days and then becomes extremely active swimming about by an upward and forward then downward and backward motion of the abdomen bearing now a pair of caudal paddles. The pupa holds the thorax upright and always keeps the respiratory filaments below the surface film. If the filaments do break through before the close of the period the pupa is unable to extricate itself and dies. On the third day the cuticle of the pupa becomes transparent and the body of the adult may be seen within. The pupa now swims with the body in a horizontal position just under the surface film. After swimming or floating for about one day, the pupa suddenly pushes its respiratory filaments through the surface film and stretching out upon the film becomes quiet. The whole pupal period is seldom more than 3 days.

*Adult:* The adult body clearly visible through the pupal skin is

now brilliant red. After a quiescent period of a few moments, the thorax suddenly bursts along the mid-dorsal line and the thorax of the adult appears. It is immediately followed by the head with the antennæ closely folded and then appears the fore part of the abdomen with the bright red wings lying along the sides of the body apparently all filled out and only needing to become dry to be useful. The middle pair of legs are drawn out first and touch the old pupal thorax at the base of the old respiratory filaments. The adult supported on these legs works the body up and down a few times and then the hind pair of legs are released and braced against the old pupal abdomen. The tip of the abdomen appears immediately and the front pair of legs come out at the same time. These legs and the wings flutter a moment and the adult flies from the water. This emergence takes about 10 to 12 seconds at times and again may be accomplished in 4 or 5 seconds. If it be prolonged beyond 12 seconds, the emergence is a failure, the tip of the abdomen and the hind legs seeming to stick.

The adult usually flies off at once but it may rest for several minutes upon the pupal skin or even upon the water, but this last may be followed by disaster. The male antennæ take shape slowly and it may be 10 or 20 minutes before he is in full plumage. The usual time for emergence is at dusk or early in the morning. Upon emergence the adults fly to the light in the indoor experiments, and straight up into the air and are lost to sight when the emergence takes place out of doors. The average time from hatching to emergence is 41 days in 26 cases with a range of 23 to 90 days. As the time of the fourth instar is variable, so is the period during which the adults from an experiment may appear, a long one. In our experiments this period extended from 10 to 81 days with an average of 32.7 days in 21 cases. The range from hatching to the last emergence for a given experiment is 27 to 118 days with an average of 71 days in 20 cases. This variation is also accountable for the continued supply of larvæ in a stream and for the presence of egg masses at almost any period of the summer.

The adults keep in dark corners and weed shelters in the day time and swarm at sunset in great masses, the males making up the greater percentage of the swarm. They move up and down in the air at various levels and remain in the air for a period of about half an hour. Fe-

males may be seen darting in and out of the swarm or sitting quietly near by. Suddenly one of these females will dart into the swarm and catch a male by the thorax with her fore legs, both individuals headed in the same direction. Instantly the male whirls about so as to head in the opposite direction and drops from the swarm carrying the female along behind. The pair drop about five feet and then, without pausing, rise again to about the level of the swarm and separate and both come to rest. In a very few moments, the male returns to the swarm but the female usually remains quiet or crawls about doing very little if any flying. Only those forms which have been emerged long enough to be thoroughly dry mate, or at least none of the mating pairs in our observations showed any red, which is the characteristic color of a newly emerged adult and the color persists for about six hours. A similar process of mating has been observed in this same genus *Chironomus plumosus* Linne by Needham.

Parthenogenesis seems not to occur in this species. Of 52 females that emerged in isolation, only 29 laid eggs and none of these were fertile.

As for the length of life of the adults, the females in captivity where their emergence was known lived an average of 4 days and 15 hours while some lived as long as 8 days. The males show an average of 5 days and 15 hours with an extreme of 17 days. As far as known, the female lays only a single egg mass.

Egg laying certainly does not take place immediately after mating as experiment records show. Three days may elapse from emergence to egg laying in unfertilized females and this same time often elapses between time of capture and the laying of eggs by a fertile female. There may therefore be approximately a week from emergence to the larval stage. This makes a six weeks cycle for the normal cases; and the observations of the crests of emergences and egg laying verify this period. We observed one crest the second week of July, which was probably the second of the season, another the fourth week of August and another the first week of October, making at least four cycles in a season. We had emergents in the indoor experiments as early as April 5th and if this were followed in the open even a week or so later there could easily be five cycles. It is not uncommon to see Chironomids flying in April and to collect eggs at that time,

but until further data is obtainable for this species we will say that there are at least four cycles for the season.

The numbers of the two sexes are about equal as determined by counts of individuals taken from the indoor rearings over a period of three months. The number reaching maturity in these experiments was only 3 per cent. for great fatalities occur at the moults and especially at the change from larva to pupa.

The species overwinters in the larval stage and is extremely resistant to freezing temperatures. Where possible the larvæ burrow into the debris and soil but may be frozen in a solid cake of ice and when thawed out become active and later pupate. They are also resistant against drought. They crawl into the mud as the water recedes; even though the dirt about them be dry enough to crack and crumble, they will revive when water is placed on them and continue their functions.

When milk particles are available nothing else is eaten or at least nothing else can be seen in stomach contents, but if this food be lacking then the larvæ will eat small green algæ. The larva apparently does not eat in temperatures below 37 degrees Fahrenheit and becomes inactive, but resumes activities at any rise in temperature.

*Summary:* We have therefore a species with an incubation period of not more than five days, a larval period of four instars with a range of 24 to 115 days, a pupal period of 3 days and an adult life of 4 or 5 days. The crests of emergence fall approximately six weeks apart and there are at least four, possibly five, cycles a season.

## DESCRIPTIONS.

*Egg Mass:* Color light brown; 5 to 10 mm. in length, 1 to 2 mm. in width. Individual eggs measure 0.28 to 0.315 mm. by 0.13125 to 0.14 mm. and are set usually on a slight diagonal in a narrow gelatinous ribbon which folds back and forth upon a hollow cylinder to form the mass. There are approximately 34 rows of 20 eggs each but this is variable for the range in numbers of eggs in a mass may be from 255 to 1,440 with an average of 525. The mass may be found attached to a stone or aquatic plant at the surface of the water (usually where there are ripples) by a gelatinous stalk which, when it reaches the mass, divides into two strands which extend the length of the hollow cylinder within the center (Plate III, Figs. 1 and 3; Plate V, Fig. 30).

*Larva:* 14 to 16 mm. in length when full grown, of a bright red color. Head dark brown, bearing two pairs of pigment spots or superficial eyes. The antennæ about one fifth as long as the head and consisting of a large but slender basal joint with one sensory pore and bearing distally two processes, one of four joints of which the first and third are the longest, the other process not jointed and shorter. Labrum prominent and fitted with one pair of dorsal hooks situated near the median line, one pair of ventral hooks lying nearer the median line than the dorsal pair; upon each side of the labrum and toward the distal edge are three hooks longer than the dorsal or ventral pair, which are graduated in length, the longest being toward the front. The anterior comb projects laterally so as to form another pair of hooks. The teeth of the posterior comb, which is a horizontal bar, are similar in shape and size, slender, pale and pointed. The mandibles large with five teeth, the distal one pale, the others black with the one adjacent to the pale distal tooth pointed as a rule but in some cases blunt; a row of hairs upon the inner face of the mesal border of the mandible projects mesad beyond the teeth; there is a single seta near the base of the mandible but upon it. The maxillæ bear a single palpus each and this is terminated with a ring of papillæ; two setæ rise near the base of each maxilla. The labium is dark with a median tooth which is rounded and longer than the first laterals but shorter than the second laterals; the second laterals rounded and closely applied to the third laterals which appear almost as shoulders of the second (Plate IV, Fig. 7). The head shows a distinct clypeal sclerite, upon which are three pairs of setæ, and two lateral sclerites which are joined ventrally and each sclerite bears dorsally two setæ. Upon the last abdominal segment is a pair of rounded caudal projections with six hairs each. The anal gills are four in number and prominent. The ventral gills, which appear at the first moult, are four in number; situated upon the eighth abdominal segment on the ventral surface. The anal prolegs bear three incomplete rows of dark bifid claws. The anterior prolegs are closely applied to each other and move as a single process; their tips are clothed with a mass of fine, curved pale hairs. (Plate IV, Fig. 19.)

*Pupa:* 5 to 9 mm. in length; bright red when newly transformed, changing to almost black. Respiratory processes of numerous fine

filaments in three main tufts upon each side of the thorax, filaments white turning to grey. Abdomen, usually partially enclosed in the old larval skin, bearing a pair of caudal fins from which issue a mass of long hairs; the eighth abdominal segment bears, laterally upon its apical edge, a pair of heavily chitinized spurs which are pentafid; abdominal segments 1 to 5 are marked laterally with a dash of dark pigment (Plate V, Figs. 27–29).

*Male:* 5.5 to 7 mm. Front of face pale, palpi 4 jointed, darker than face; antennæ 12 jointed, dark; the basal joint subglobular, large; the second joint twice as long as broad; joints 3 to 11 twice as wide or wider than long; the 12th joint longer than all others put together; all but basal joint plumose, hairs pale and unicolored. Eyes glabrous and black. Dorsum of thorax yellow with the usual three stripes, which in this species are cinereous brown with a grayish bloom; the middle stripe divided into two by a pale median line, the stripe is continued to the scutellum by a narrow dark line. Scutellum pale; metanotum and mesosternum brown. Wings finely punctate, venation as figured (Plate V, Fig. 25) not reaching beyond the sixth abdominal segment; veins yellow, cross vein brown. Coxæ yellow, legs greenish yellow and pilose; of all legs, tips of the femora, tibiæ and first, second and third tarsal joints dusky; fourth tarsal joint sometimes all dark, fifth tarsal joint always dark; claws distinct and black. Knees of fore legs dark and basal joint of tarsi having a relation of 52:36 with tibia; fore tarsal joints bare; tip of tibia lacking a comb. Tips of tibiæ of middle and hind legs bearing an incomplete comb with two of the teeth produced into sharp dark spurs. Abdomen with cinereous brown bands which lie at the base of the segment; each band is somewhat wider at the middle where it is prolonged into a fine line sometimes reaching the posterior margin of the segment; segments 1 to 5 pale on the venter; segments 6 and 7, cinereous markings continuous upon venter; 8 and 9 without markings all palely cinereous brown; segment 9 bearing apically a pale median hook; forceps of 3 pairs and as figured in Plate V, Figs. 32, 33, 34.

*Female:* 5.0 to 6.5 mm. Face and palpi as in male. Antennæ 6 jointed, yellow except apical joint which is brown; the basal joint subglobular; the second apparently a fusion of two as it bears two

rows of sensory pores the basal row of which is not possessed of sensory hairs, the outline of the segment is constricted but there is no evidence of a suture; segments 2 to 5 bottle shaped, the terminal joint as long as 3, 4 and 5 combined; all joints except basal have a single row of sensory hairs. Eyes glabrous. Thorax as in male. Wings finely punctate and reaching to middle of segment 8. Legs as in the male. Abdomen broad, segments with wide cinereous band covering all but a narrow posterior margin which is pale. Segments 1 and 2 pale on the venter; 3 to 7 marked all around, 8 and 9 palely cinereous; ovipositors of one pair, pale (Plate V, Figs. 35, 36, 37).

*Distribution:* New York, Illinois, Washington, Kansas, Idaho, South Dakota, and New Jersey.

## BIBLIOGRAPHY.

HOLMGREN, NILS (1904). Zur Morphologies des Insektenkopfes. Zeitschrift für wiss., Bd. 76.

JOHANNSEN, OSCAR AUGUSTUS (1905). Aquatic Nematocerous Diptera, II. N. Y. State Museum Bulletin, 86.

KIEFFER, J. J. (1913). Nouvelle Etude sur les Chironomidæ de l'Indian Museum de Calcutta. Rec. Ind. Mus., Vol. IX, Pt. III, July, '13.

MALLOCH, JOHN R. (1915). Chironomidæ of Illinois. Bulletin of Ill. St. Lab. of Nat. Hist., Vol. X, Art. VI.

MIALL AND HAMMOND (1900). The Harlequin Fly.

NEEDHAM, JAMES G. (1907). Notes on the Aquatic Insects of Walnut Lake. Report of the Board of Geological Survey of Michigan, 1907.

## EXPLANATION OF PLATES III, IV AND V.

### PLATE III.

FIG. 1. Egg masses much enlarged.
FIG. 2. Egg masses on grass, slightly enlarged.
FIG. 3. Egg mass showing characteristic arcuate shape.
FIG. 4. Larval tubes, natural size.
FIG. 5. Egg masses on a stone, natural size.
FIG. 6. A clump of larval tubes, natural size.

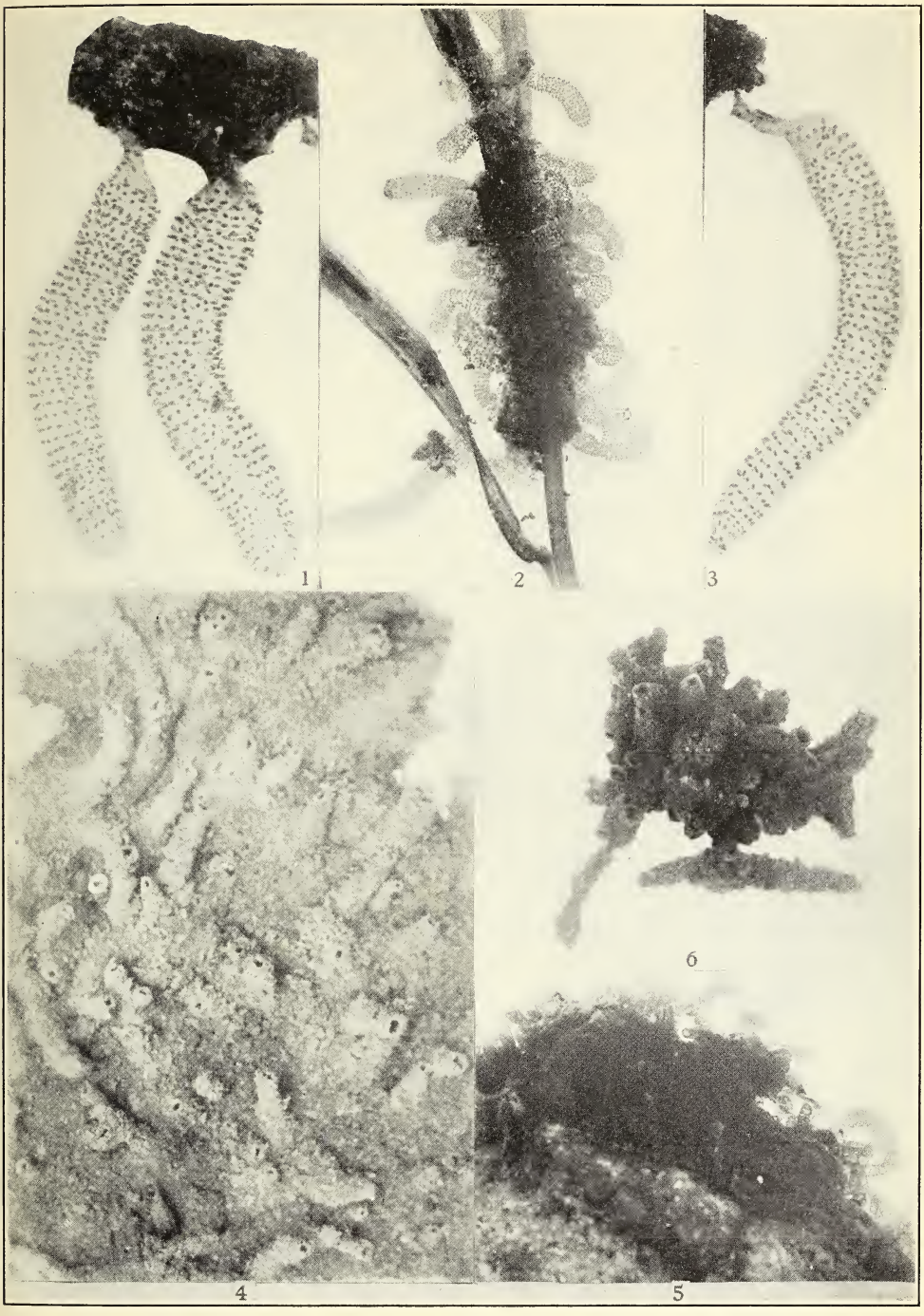
### PLATE IV.

FIG. 7. Labial border of full-grown larva, fourth instar. 330 ×.
FIG. 8. Labial border of larva of third instar. 575 ×.
FIG. 9. Labial border of larva of second instar. 1,150 ×.
FIG. 10. Labial border of larva of first instar. 1,700 ×.

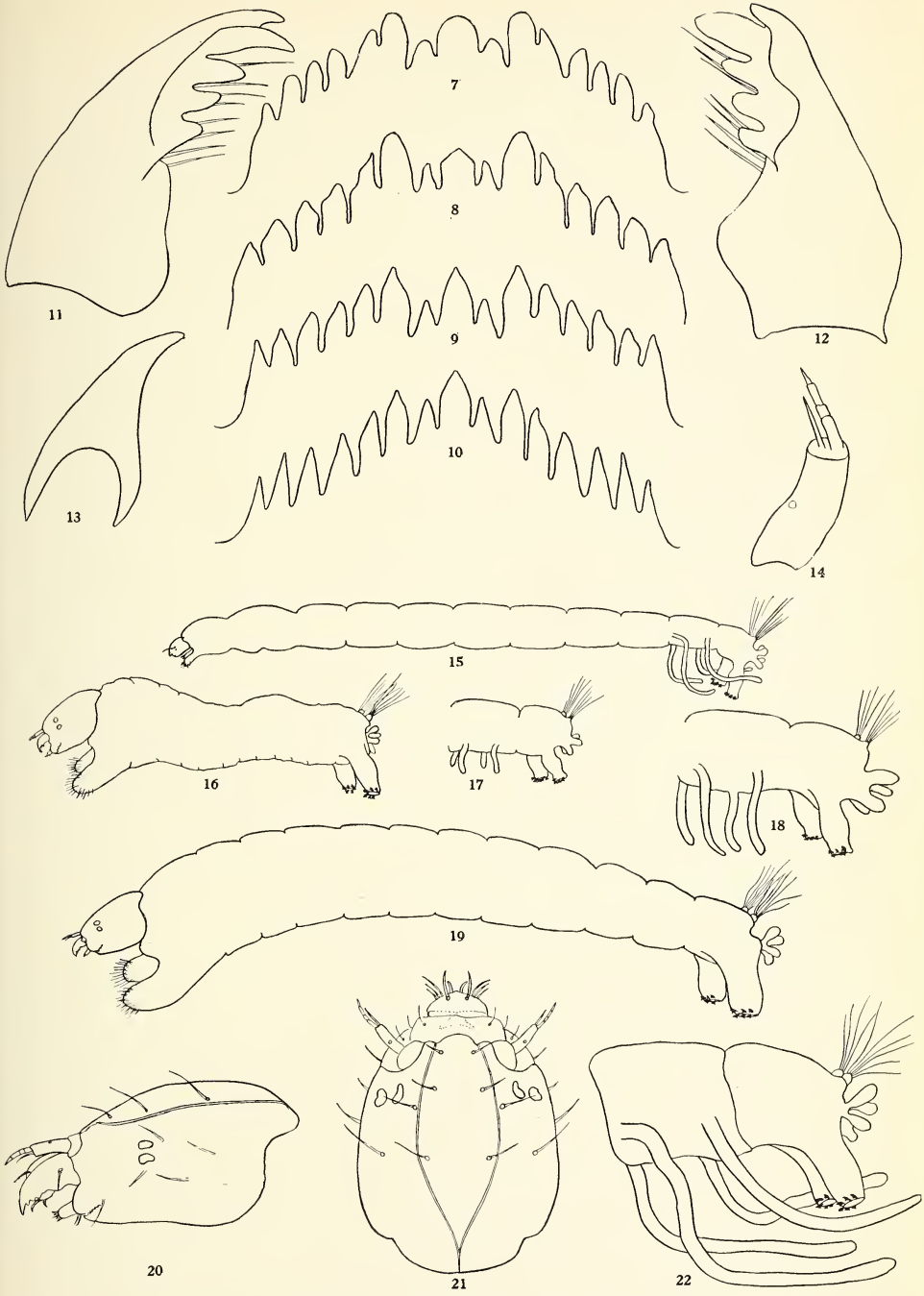
FIG. 11. Mandible of full-grown larva with fourth tooth rounded. 220 ×.
FIG. 12. Mandible of full-grown larva with fourth tooth pointed. 220 ×.
FIG. 13. Bifid claw of the anal proleg. 300 ×.
FIG. 14. Antennæ of larva, dorsal view. 210 ×.
FIG. 15. Grown larva. 5 ×.
FIG. 16. Newly hatched larva. 80 ×.
FIG. 17. Last two abdominal segments of a larva of the second instar. 45 ×.
FIG. 18. Last two abdominal segments of a larva of the third instar. 25 ×.
FIG. 19. Larva one day old. 80 ×.
FIG. 20. Lateral view of head of full-grown larva. 50 ×.
FIG. 21. Dorsal view of head of full-grown larva. 50 ×.
FIG. 22. Last two abdominal segments of a full-grown larva. 15 ×.

## PLATE V.

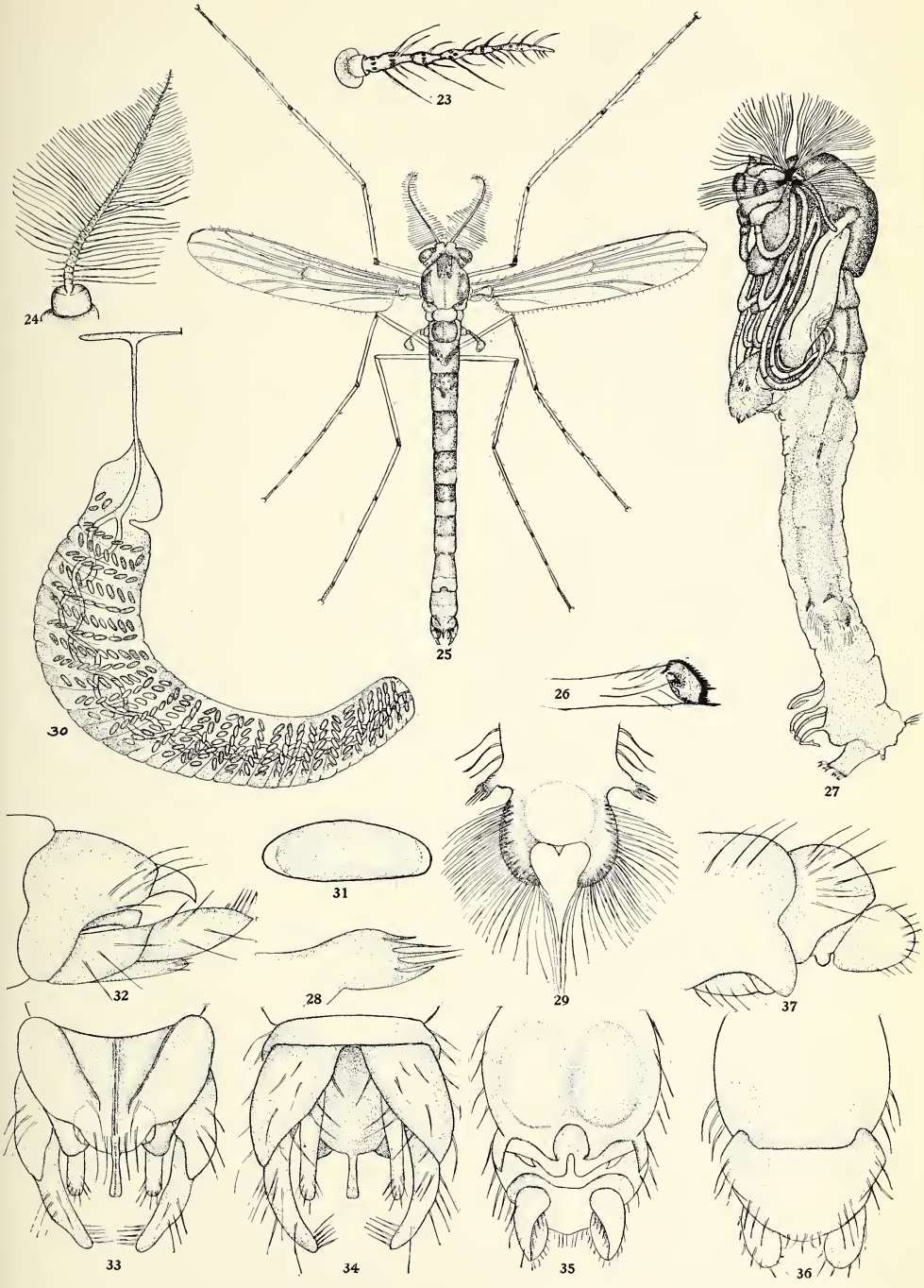
FIG. 23. Antenna of female adult. 35 ×.
FIG. 24. Antenna of male adult. 25 ×.
FIG. 25. Dorsal view of male adult. 10 ×.
FIG. 26. Distal end of middle tibia to show comb. 100 ×.
FIG. 27. Lateral view of pupa with larval skin not completely shed. 10 ×.
FIG. 28. Spur of eighth abdominal segment of pupa. 200 ×.
FIG. 29. Caudal fins of pupa. 25 ×.
FIG. 30. Egg mass. 15 ×.
FIG. 31. A single egg. 55 ×.
FIG. 32. Genitalia of male, lateral view. 60 ×.
FIG. 33. Genitalia of male, dorsal view.
FIG. 34. Genitalia of male, ventral view.
FIG. 35. Genitalia of female, ventral view. 55 ×.
FIG. 36. Genitalia of female, dorsal view.
FIG. 37. Genitalia of female, lateral view.




CHIRONOMUS CRISTATUS, FABRICIUS




CHIRONOMUS CRISTATUS, FABRICIUS




CHIRONOMUS CRISTATUS, FABRICIUS

# MORPHOLOGY OF THE HEAD OF TRICHOPTEROUS LARVÆ AS A BASIS FOR THE REVISION OF THE FAMILY RELATIONSHIPS.[1]

BY JOSEPH KRAFKA, JR.

UNIVERSITY OF GEORGIA, ATHENS, GA.

## INTRODUCTION.

The general and detailed anatomy of trichopterous larvæ has been thoroughly dealt with by several well-known investigators. A study of the sclerites of the head has led the author to a reconsideration of the phylogeny within the group, and the conclusions reached by him seem to warrant this addition to the literature.

The generally accepted classification of the Trichoptera gives as the stem form the family Rhyacophilidæ. The Hydroptilidæ or microtrichopterans are considered an early offshoot as are also the Philopotamidæ. In the same way the Psychomyidæ, Polycentropidæ and Hydropsychidæ possess certain relationships. These six families constitute a major subgroup. The remaining seven families make up a second subgroup. They are the Calomoceratidæ and Odontoceridæ; the Leptoceridæ and Molannidæ; the Phryganeidæ, Limnophilidæ and the Sericostomatidæ. The family relationships are as suggested here although the last family is made up of four subfamilies of somewhat doubtful affiliations.

The first subgroup has thysanuriform or campodeiform larvæ; the last group has eruciform larvæ. The outcome of the present study indicates that the stem form is to be found not in the campodeiform group, but rather in the eruciform group, namely the Leptoceridæ; and that the campodeiform is a specialized rather than a primitive condition among trichopterous larvæ.

## ACKNOWLEDGMENTS.

The present study had its origin in a problem undertaken at the suggestion of Dr. Cornelius Betten in 1913. The results were pub-

[1] Contributions from the Entomological Laboratories of the University of Illinois, No. 68. The publication of this paper has been made possible through an appropriation for plates by the University of Georgia, D. C. Barrow Chancellor.

lished at that time in the form of a key to Trichopterous larvæ (Krafka, 1915). The possibility of the relationships as herein indicated was first suggested to the author by Dr. Alex. D. MacGillivray, and the work has progressed under his direction.

The Illinois State Laboratory of Natural History has kindly loaned material some of which has proved exceptionally valuable. The greater part of the material comes from the private collection of Dr. Betten. The nature of my indebtedness to him is rather unusual. At his suggestion I first undertook the study of the trichopterous larvæ. These studies have led to conclusions seemingly opposed to his own. Yet his criticism has been generously given and he has lent assistance in every way possible to facilitate the successful outcome of the studies.

All heads described are figured. The explanation of the plates gives the source of the specimens.

## CAMPODEIFORM AND ERUCIFORM LARVÆ.

1. *General Meaning and Significance:* The campodeiform (thysanuriform) and eruciform types of larvæ have been recognized in many orders of insects as respectively generalized and specialized in their organization. Folsom in his textbook of Entomology differentiates them as follows: "The former term is applied to many larvæ and nymphs on account of their resemblance to the Thysanura." "The resemblance lies chiefly in the flattened form, hard plates, long legs and antennæ, caudal cerci, well-developed mandibulate mouth-parts and active habits with the accompanying sensory specialization. These characteristics are permanent in Thysanura, but only temporary in metamorphic insects, and their occurrence in the latter forms may properly be taken to indicate that these insects have been derived from ancestors which were like Thysanura.

"These primitive characters are gradually overpowered in course of larval evolution, by secondary, or adaptive features.

"The prevalent type of larvæ among holometabolous insects is the eruciform, illustrated by a caterpillar or maggot. Here the body is cylindrical and often fleshy, the integument weak; the legs, antennæ, cerci and mouthparts reduced often to disappearance; the habits sedentary and the sense organs correspondingly reduced.

"The eruciform is clearly derived from the thysanuriform type as

Brauer and Packard have shown; the continuity of the two types being established by a complete series of intermediate stages."

2. *Occurrence in Trichoptera:* The two types of larvæ have long been recognized in the Trichoptera. The chief characteristics of each group may best be listed as opposites.

| CAMPODEIFORM. | ERUCIFORM. |
|---|---|
| 1. Long axis of the head continuous with long axis of the body. | 1. Long axis of the head at right angles with the long axis of the body. |
| 2. Mouth directed cephalad. | 2. Mouth directed ventrad. |
| 3. Body depressed. | 3. Body cylindrical. |
| 4. Legs long, generally all about same length. | 4. Front legs much shorter than other two pairs. |
| 5. Abdominal segments sharply constricted. | 5. Abdominal segments faintly indicated. |
| 6. Prolegs long, slender, and movable. | 6. Prolegs short, thick, and fixed. |
| 7. Lateral line wanting. | 7. Lateral line generally present. |
| 8. Prosternal horn wanting. | 8. Prosternal horn sometimes present. |
| 9. Abdominal tubercles wanting. | 9. Abdominal tubercles usually present. |
| 10. Rectal blood gills generally present. | 10. Rectal blood gills wanting except in Leptoceridæ. |
| 11. Free living, net builders, except Hydroptilidæ. | 11. Building portable cases. |

The characteristics peculiar to the campodeiform larvæ in the Trichoptera are those distinguishing the campodeiform larvæ of other orders of insects, while the same is true for the eruciform. Furthermore the various structures of the body may be arranged in an intergrading series consistent with the idea that the eruciform type is derived from the campodeiform.

This hypothesis is given additional support by the relationships as established among the adults. The Rhyacophilidæ have been taken as the stem form, since some members of this family retain the venation of the hypothetical wing type of Comstock. Furthermore those families which are placed nearest the Rhyacophilidæ on the basis of wing venation are characterized by campodeiform larvæ.

These three facts would seem to establish beyond a doubt the relationship within the order, at least as far as the two main groups are concerned.

## MORPHOLOGY OF THE HEAD.

1. *Methods of Study:* While the study of insect anatomy entails no special technique, it is well in an investigation of this type to give the principal steps in the method used.

The larvæ were preserved in 75 per cent. alcohol. They were not taken from their cases when collected. When ready for study, they were removed by pulling them out with a pair of forceps or by splitting the case. They were then dropped into boiling caustic potash to clear and soften. The abdomen was then snipped and the internal parts removed by pressure upon the chitinous parts. The heads were removed and studied separately, drawings being made of the dorsal, ventral and lateral aspects. The details were determined from specimens mounted in balsam. In most cases the whole dorsal and ventral aspects of the head were preserved by splitting the head along the lateral margin from the mandible to the occipital foramen. On one half, the fronto-clypeus, labrum and right mandible were thus held intact, while the gula, labium, maxillæ and left mandible were likewise preserved in position on the other half. Drawings were made with a compound microscope and a camera lucida. The magnification varies, as an attempt was made to have all the drawings of a uniform size.

2. *General Description of the Head:* The head capsule is an elliptical box with two large openings, the occipital foramen and the oral foramen. It is composed of three primary sclerites; a median cephalic fronto-clypeus, a vertex, and a median ventral gula (Plate VI, Figs. 1, 2, 3). The fronto-clypeus is a flat plate bounded on each side by the arms of the epicranial suture, while its cephalic margin is a long transverse border to which the membranous preclypeus is attached. The labrum is joined to the preclypeus. The caudal end of the fronto-clypeus is pointed, fitting into the angle formed by the arms of the epicranial suture. The lateral margins are either straight, regularly curved or sharply indented near their middle. These indentations mark the places of invagination of the pretentoria.

The vertex forms the greater part of the head capsule; it is separated on the dorsal aspect of the head by the fronto-clypeus and on the caudal aspect to the occipital foramen by the stem of the epicranial suture. The vertex extends laterad and ventrad to form the

lateral and the greater part of the ventral aspect of the head. In some forms the vertex is contiguous for the greater part of its length on the ventral aspect, being separated only by the gular suture. In other forms, however, it is widely separated by the gula itself (Plate VIII, Fig. 43). In this case the gula extends from the occipital foramen to the proximal end of the labium, but in the former case it is restricted to a small triangle adjacent to the labium. In the first case the vertex alone surrounds the occipital foramen. In the latter case the gula and vertex together bound it. The vertex bears the eyes and the antennæ. The labrum is a subelliptical sclerite which serves as an upper lip. It is generally notched on its free margin. The preclypeus which attaches it to the fronto-clypeus is inserted a short distance cephalad of the posterior edge. The ventral aspect is generally membranous, heavily bristled and continued caudad as the epipharynx.

3. *Mouth-parts:* The mandibles are roughly pyramidal or pyriform. The articulations are of the acetabulum-condyle type. The dorsal articulation has the acetabulum on the mandible and the condyle on the vertex, while in the ventral one the conditions are reversed (Plate VI, Fig. 2). Movements of the mandibles are effected by two tendons which swing them on their articulations like a gate. Flat scissors-shaped and thick chisel-shaped mandibles occur. Their inner surfaces are either toothed for grasping or hollowed out for crushing. The inner basal margins are attached to the lateral membranes of the mouth.

The labium and maxillæ are united and together form an under lip. The labium is median in position and has its basal attachment on the cephalic margin of the gula. Its shape is more or less triangular, broad at the base and terminating in the hemispherical segment, the fused stipulæ. This terminal segment bears a pair of one or two segmented labial palpi, while at its tips, the fused glossæ. is the single opening for the salivary glands.

The maxillæ are generally about the same length as the labium. The basal attachment is by means of the chitinous cardo. The stipes is a small flexible, subcylindrical segment with its mesal margin fusing with the lateral margin of the submentum. Its basal and lateral margins are attached to the cardo, vertex and the inner basal membranes of the mandibles. The stipes is supported by a chitinous cuff

that nearly surrounds it. The stipes itself is not capable of much independent movement, but together with the labium, the lower lip moves freely. The terminus of the maxilla is generally composed of two parts, the galea and the maxillary palpus. In some cases they are fused along their adjoining faces to form a single flexible projection which is heavily armored with bristles and supplied with numerous sense organs. The maxillary palpi are either four or five segmented. The segments of these palps are usually not completely chitinized; the chitinization being in the form of a cuff and leaving the mesal surface open to movement. The proximal segment of the maxillary palpus is generally indistinguishable from the proximal end of the galea except for the cuff.

The membranous glossæ are continuous with the parapharynx. The lateral boundaries of the labium are not clearly separated from the maxillæ, especially in the cases where chitinization is slight. The mentum and submentum are likewise not distinguishable. The submentum however generally bears a single large median plate or a pair of small plates.

The eyes generally consist of six simple, closely adjacent, ocelli, placed on a pigmented eye-spot. These eyes are slightly elevated. Their position on the vertex varies from a point near the latero-cephalic margins of the head to a point as far caudad as the separation of the epicranial arms.

The antennæ are simple. Siltala recognizes two types: one with two distal pieces, the other with only one. Their position varies with that of the eyes from immediately behind the mandibles to a point far up on the head.

4. *Internal Skeleton:* The endoskeleton of the head is greatly reduced. The tentoria consist of a single pair of flexible fiber-like arms extending through the head from the dorsal to the ventral wall. The dorsal invaginations are found in the indentations of the epicranial arms, while the ventral invaginations are located in the angles formed by the gula and the vertex in the open type and near the caudal ends of the gular suture in the closed type. The supratentoria and corpotentoria are not present in the late larval stages, although I found a single corpotentorium in an early instar of *Mystrophora americanum*.

The above general description is well illustrated by the Phryganeid in Plate VI, Figs. 1, 2, 3 and 4. While there is considerable variation in the structure and arrangement of the various sclerites and appendages, there is a remarkable consistency in the occurrence of the described parts, and in no family are the deviations so marked that the sclerites may not be readily identified.

## COMPARATIVE STUDY OF HEAD.

1. *Fronto-clypeus:* This shield-shaped sclerite presents a fascinating study in its variation, for here Nature has escutcheoned the genealogy of the order. The simplest type is found in the straight-sided, roughly pentagonal, head piece of Leptocerid 26720 (Plate VI, Fig. 5). From this simple type three principal changes are evident: (1) the rounding of the pointed end; (2) the flaring at the cephalic margins; (3) the indentations of the lateral margins in association with the pretentoria. These three changes may follow a primary tendency to widen the fronto-clypeus, the resultant ornate character of the epicranial arms being due to the anchoring effect of the pretentoria.

Leptocerid I and Leptocerid III illustrate the initiation of these changes (Plate VI, Figs. 6 and 7), while *Leptocella uwarowii* and *Mystacides sepulchralis* show them emphasized still further (Plate VI, Fig. 9). An unusual development of the cephalic margin is characteristic of Leptocerid II (Plate VI, Fig. 8).

The Molannidæ approximate the Leptoceridæ in the shape of the fronto-clypeus. Except for the anterior margin, which is regularly bowed, *Molanna cinerea* (Plate VI, Fig. 10) is a duplicate of *L. uwarowii. Molanna* II is a change in the same direction although marked by a chitinous ridge near the cephalic margin (Plate VI, Fig. 11).

The Phryganeidæ specialize in the development of the cephalic flares of the epicranial arms. The arms curve outward sharply as they approach the clypeal suture until they are nearly parallel with it. Then with a right angle bend they meet the latter, forming a small, squarish, projecting corner (Plate VI, Fig. 1).

The type of fronto-clypeus developed in the Phryganeidæ persists with little modification in the remaining families of eruciform larvæ. It is repeated almost to identity in the Calamoceratidæ, Limnophilidæ, and Sericostomatidæ (Plate VI, Figs., 12–18). The ex-

pected exceptions are presented in the Odontoceridæ and in a few genera of the sub-family Brachycentrinæ.

The Odontoceridæ lack the small squarish latero-cephalic corners; the epicranial arms proceeding directly to the clypeal suture without bending outward. The same conditions are found in the Brachycentrinæ mentioned above. The evidence that these two similar conditions were brought about in different ways will be presented in the discussion of the chætotaxy of the head.

It is with interest that we find the same developmental tendencies in the campodeiform and the eruciform groups. The Hydroptilidæ (Plate VII, Fig. 19) very closely resemble the Leptoceridæ, while the Rhyacophilidæ approximate the phryganeid pattern, although in the latter the cephalic part of the sclerite is markedly shorter (Plate VII, Fig. 38).

The Philopotamidæ and the Polycentropidæ show approximately the same type of fronto-clypeus as the Phryganeidæ, except for the cephalic flares. The Philopotamidæ are peculiar in that the cephalic margin of this sclerite is asymmetrically notched (Plate VII, Fig. 23).

The subfamily Glossosomatinæ depart from the phryganeid pattern in that the epicranial arms take a concave rather than a convex course from the pretentoria to the clypeal suture. This tendency is repeated again in a few hydropsychids and may possibly suggest a relationship.

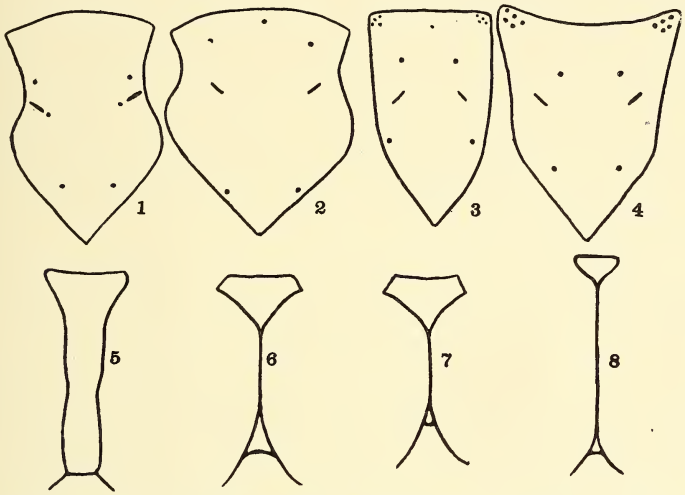
The Hydropsychidæ of the Eastern United States examined by the author showed a fronto-clypeus which is strikingly different from any other in the order and for a time presented a discontinuous example in an otherwise orderly array. It is roughly triangular and apparently bore no relation to the other types. Through material obtained at Tolon, Colorado, and Soda Butte, Montana, the successive steps in the development of this odd form were made out.

In *Hydropsyche* 27006, the fronto-clypeus is shield-shaped. The lateral margins are formed by a double curve of the epicranial arms, which at first diverge widely, then with a slight curve converge again to points marked by the pretentorinæ. A short outward curve carries them to the convex cephalic margin (text figure 1).

*Hydropsyche* 27256 has a broader and a longer apex. The epi-

cranial arms do not converge to the degree exhibited by 27006. The resulting sclerite is broad and shield shaped (text figure 2).

In *Hydropsyche incommoda,* the epicranial arms are nearly straight (text figure 3), forming a roughly triangular sclerite which is characteristic of nearly all Hydropsychidæ and the Macronematinæ (text figure 4).




TEXT-FIGURE. 1. Fronto-clypeus of *Hydropsyche* 27006 Ill. St. Lab. Nat. Hist. 2. Fronto-clypeus of *Hydropsyche* 27256 Ill. St. Lab. Nat. Hist. 3. Fronto-clypeus of *Hydropsyche incommoda.* 4. Fronto-clypeus of *Macronema zebratum.* 5. Gula of *Hydropsyche* 27006 Ill. St. Lab. Nat. Hist. 6. Gula of *Hydropsyche* 27256 Ill. St. Lab. Nat. Hist. 7. Gula of *Hydropsyche incommoda.* 8. Gula of *Macronema zebratum.*

Series to demonstrate the simultaneous and correlated development of the dorsal and ventral aspects of the head in the Family Hydropsychidæ.

The three stages given here present a consistent series connecting the aberrant hydropsychid pattern with that of the phryganeid. They indicate the broadening of the sclerite by the shifting of the epicranial arms.

That such a shift has actually taken place is supported by the evidence of the pretentorinæ. In all fórms of trichopterous larvæ, except the Hydropsychidæ, the invagination marking the internal skeleton is directly associated with the epicranial arms. In one Mo-

lannid the invaginations form a deep depression that lies along the suture (Plate VI, Fig. 11). In *Hydropsyche* 27006 the pretentorinæ are slightly removed from the epicranial arms. In *Hydropsyche* 27256 they are still further removed. In most of the Hydropsychidæ they are displaced to such a distance that one would no longer associate them with the arms.

Thus while the pretentorinæ have retained their original position on the head, the epicranial arms have moved out and away from them, doubtless due to the tendency to broaden the head. In all forms but the Hydropsychidæ, the pretentorinæ have acted as anchoring points and have given the arms their sinuous character. In the Hydropsychidæ the arms have freed themselves and have left the pretentorinæ isolated. We may thus fix the hydropsychid pattern in the phryganeid series.

2. *Chætotaxy of Fronto-clypeus:* A very interesting set of relationships appear with the study of the bristles of the fronto-clypeus. The Leptoceridæ with the straight-sided fronto-clypeus possess only three pairs of bristles (Plate VII, Fig. 28). The first pair, I, are just caudad of the pretentorinæ. The second pair, II, are immediately cephalad, while the third pair, III, are still further removed from the pretentorinæ. The majority of Leptoceridæ have an additional fourth pair, IV, near the cephalo-lateral angles, and a fifth pair, V, slightly laterad to these (*Mystacides sepulchralis,* Leptocerid I, Leptocerid II, Leptocerid III, Leptocerid 13839). *Leptocella uwarowii* presents an additional sixth, VI, between IV and V (Plate VII, Fig. 29).

The Molannidæ show the same three pairs of lateral bristles but with four pairs on the cephalic margin instead of two (Plate VII, Fig. 30). These seven pairs are again present in the Phryganeidæ and the pattern here assumed is repeated with surprising uniformity in the remainder of the eruciform larvæ (Plate VII, Figs. 31–36).

The single median pit is also a noticeable feature of all the eruciform group, with the exception of the Leptoceridæ. This structure has the appearance of a calyx, but I have never found a seta attached at this point.

The few exceptions to typical chætotaxy occur in those forms in which the fronto-clypeus is also exceptional. *Brachycentrus,* lacking the cephalic flares, has only two pairs of bristles on the cephalic

margin. The central pit is also absent. This condition suggests relationship with the Leptoceridæ and is further supported by the evidence of the gula. The other exception is *Psilotreta* where but three cephalic pairs were found instead of the typical four (Plate VII, Fig. 35). A fourth pair however were discovered on the vertex in close proximity to the cephalo-lateral corners. The fronto-clypeus in this form is slightly different from the rest of the higher eruciform larvæ. The epicranial sutures proceed directly to the cephalic margins without the little bends that produce the small squarish corners in the sclerite. Were these present they would include this fourth pair of setæ. In no other form of the eruciform larvæ are there any setæ present on the vertex in close proximity to the clypeus at its anterior margin. The fourth pair then in *Psilotreta* is probably represented by this pair displaced on the vertex, and suggests a shift from the phryganeid pattern.

The exact position of the seven pairs of setæ may vary slightly in the several eruciform families or even within a genus, but the general relationship is practically constant.

In the campodeiform group, the same general pattern is present but with a greater diversity in number and arrangement of the setæ. Hydroptilid II shows a clypeus similar in chætotaxy to that of the Leptoceridæ (Plate VII, Fig. 37). In the remaining families some interesting modifications are to be found.

The Rhyacophilidæ show a peculiar tendency to double the bristles I, II, III. Instead of a single bristle as in *Mystrophora americana* there are two (Plate VIII, Fig. 43), one lying directly mesad of the other. Instead of II in its usual place near the pretentorinæ (*P*), a pair of setæ is found on either side. At a first glance, III is absent; or possibly one of the pair in the normal position of II may be III. The interpretation is best given after reference to conditions in closely related material. Setæ IV, V, VI, and VII are in their normal position in the latero-cephalic corners.

*Rhyacophila fuscula* (Plate VII, Fig. 38): shows a pair of setæ on each side in place of I. Their arrangement, however, is anterior-posterior instead of lateral as in *Mystrophora.* Here again as in *Mystrophora,* we find a pair of setæ where II should be. Seta III is present in its normal position so that the interpretation of the pair is clear.

Setæ IV, V, and VII are in their normal position. VI is found on the vertex as in *Psilotreta.*

Returning to *Mystrophora americana* again, the explanation of the pair of setæ at II is suggested by the condition in *R. fuscula.* A consideration of the shape of the fronto-clypeus in *M. americana* makes this explanation more certain. The lateral margin of this sclerite is concave on the cephalic half and convex on the caudal half. In the majority of Trichoptera the margin is concave on both halves. An examination of the vertex in the proximity of where III should be, brought to light a pair of setæ that would have the position of III if the clypeus were of the normal type.

Other representatives of the Glossosomatinæ and the Rhyacophilinæ show a similar doubling of setæ I, II, and III.

In the Polycentropidæ a somewhat similar condition is met. Seta I is single and varies in position from near the apex in Polycentropid 13942 (Plate VII, Fig. 40) to a point near the pretentorina in *Phylocentropus* sp.? (Plate VII, Fig. 41). Seta II is double and situated about half way between the pretentorina and the cephalic margin. In Polycentropid I, one of the members of the pair is mesad and cephalad to the other. In *Phylocentropus* the one is so far removed from the other that it is nearer III than it is to its fellow.

In *Polycentropus* I (Plate VII, Fig. 21), seta VII is in the corner, while setæ, V, VI and IV form a small triangle half way between the corner and the median line. In *Phylocentropus* setæ VII, V, and VI are in a straight line with IV slightly cephalad.

The chætotaxy of the Philopotamidæ is even more complicated. Seta I is single and located far caudad, while seta II is double. In Philopotamid 26993 (Plate VII, Fig. 23), one member of the pair is directly mesad to the other, forming a straight line across the clypeus. In *Chimarrha* sp? (Plate VII, Fig. 39) one member of the pair is situated directly cephalad of the other, forming a polygon. Seta III is situated far cephalad, is single and is associated with setæ VII, V, VI, and IV. In the last-named species it assumes a position in the latero-cephalic corners, while the four remaining setæ are grouped on an asymmetrical projection in the cephalic margin. Other Philopotamidæ present various similar arrangements. In several species where the clypeus is extremely asymmetrical, the median calyx is wanting.

In the Hydropsychidæ, the setal arrangement is obscured by the presence of a large number of secondary setæ. Setæ I and II alone are distinguishable.

It is thus apparent from a study of the fronto-clypeus that while variation occurs in shape and chætotaxy, they may all be referred to a common type. This plan has its simplest expression in the Leptoceridæ. The eruciform and campodeiform groups can readily be distinguished from one another by their own peculiarities. The eruciform larvæ tend to perfect the phryganeid pattern in both shape and chætotaxy. The campodeiform larvæ lack the regularity of the eruciform larvæ and individual patterns are developed in the separate families.

3. *Gula:* This sclerite gives an even more instructive series than the one previously discussed, for in the family Hydropsychidæ we find evidence that is indisputable in its confirmation of the new genealogy. In many other families are found straggling remnants of this piece, clearly marking the phylogenetic trail.

I have applied the terms open and closed gula respectively to those cases where the gula reaches the occipital foramen; and where the two parts of the vertex are contiguous preventing the gula from reaching the occipital foramen (Plate VIII, Figs. 44 and 49).

The Leptoceridæ show the greatest development of the open type. In Leptocerid II, the gula is a short broad plate that widely separates the vertex (Plate VIII, Fig. 47). In *Leptocella uwarowii* it is a triangular piece (Plate VIII, Fig. 46), while in *Mystacides* it is a large and quadrilateral area (Plate VIII, Fig. 45). In the Œcitinæ is has the appearance of being overdeveloped. Thus in Leptocerid I it is more than half the width of the head. It is roughly elliptical in shape, while the vertex has a tendency to enclose it (Plate VIII, Fig. 44). The same is true in Leptocerid 11561, except that the shape is quadrilateral, while in Leptocerid 26720 it is sub-crescentic (Plate VIII, Fig. 43).

The gula of the Molannidæ is very much like that of *Mystacides*. They are roughly quadrilateral and distinctly of the open type (Plate VIII, Fig. 48).

The Phryganeidæ show a transition from the open to the closed type. Phryganeid II has an open gula. It is long, narrow, and straight at the cephalic end and roundly pointed at the caudal end.

While the vertex almost encloses the gula, it does not meet behind. it. But in *Neuronia postica,* the same style of gula is completely enclosed (Plate VI, Fig. 3).

Other intermediate stages from an open to a closed gula are to be found in the Calamoceratidæ. In *Ganeonema americanum* the main part of the gula is restricted to an enclosed triangle but its strongly pointed end fills the gular suture for nearly its entire length (Plate VIII, Fig. 49).

Similar transitional stages are found in the family Limnophilidæ. *Neophylax* sp. has an open T-shaped gula (Plate VIII, Fig. 50). The vertex almost encloses it but does not meet behind it. In Limnophilid 13277 a gula similar to that of *Ganeonema* is present (Plate VIII, Fig. 51). For a further reduction of the gula, the remaining figures of the Limnophilidæ and the Odontoceridæ should be compared. The extreme condition is represented by *Helicopsyche* and *Psilotreta* (Plate VIII, Figs. 52–55).

Another series of a more striking type is found in the family Sericostomatidæ. The subfamily Brachycentrinæ has a widely open gula (Plate VIII, Fig. 57), the Lepidostomatinæ show a peculiar transitional type, while the gula is enclosed, the vertex fails to meet behind it, and a pair of pseudo-sutures follow those between the gula and the pleuræ on either side (Plate VIII, Fig. 59). The Gœrinæ have a small triangular enclosed gula which is but slightly removed from the occipital foramen (Plate VIII, Figs. 56 and 58).

Most descriptions of the campodeiform larvæ limit the gula to a small triangular sclerite at the proximal end of the labium, or in some cases indicate the complete absence of the gula. The present study shows definitely the limits of the gula and the steps by which it has been restricted.

The Hydroptilidæ have a short broad gula at the proximal end of the labium. It is roughly triangular or keel-shaped. There is also a small triangular sclerite at the end of the gular suture in the angle formed by the junction of the two parts of the vertex. The importance of this small sclerite will become apparent in the discussion of the Hydropsychidæ (Plate IX, Fig. 60).

The gula of the Glossomatinæ (*Mystrophora*) is a sclerite similar in shape to that of the Hydroptilidæ. That of the Rhyacophilinæ is

rather large and pentagonal. A very small area of cuticle is noticeable at the end of the gular suture in every specimen examined (Plate IX, Fig. 61).

The Polycentropidæ and Philopotamidæ are similar in having a broad, short, triangular gula (Plate IX, Figs. 62 and 63).

Most of the Hydropsychidæ have a gula shaped like that of the Rhyacophilidæ. This family of Trichoptera furnishes the material for the interpretation of the gular reduction. *Hydropsyche* 27006 has a gula which reaches from the labium to the occipital foramen. It is rather broad, with sides nearly straight and parallel, but diverging at the cephalic ends into a wide flare (text fig. 5 and Plate IX, Fig. 65).

*Hydropsyche* 27256 has a gula consisting of two pieces, such as would be formed from one like 27006 if the vertex came together near its middle, thus cutting it into a cephalic and a caudal half (text fig. 6 and Plate IX, Fig. 66).

*Hydropsyche incommoda* has a gula which is irregularly pentagonal. At the base of the gular suture is a minute area which represents all that is left of the caudal piece (text fig. 7 and Plate IX, Fig. 67). *Macronema* has a similar piece wedged into the gular suture, while its cephalic part is further reduced to a small triangular piece (text fig. 8 and Plate IX, Fig. 68).

These three steps in the reduction of the gula alone would indicate the direction of evolution within the order. For it is hardly conceivable that the open type could originate through the spontaneous appearance and the gradual enlargement of the sclerite at the base of the gular suture; that this sclerite could fuse with the enclosed triangular piece already present and that the two together form the broad open type.

Furthermore, the development of the ventral and dorsal aspects of the head are fully correlated. When the data already presented on the fronto-clypeus is compared with that of the gula, we find a complete corroboration.

*Hydropsyche* 27006 has a long open gula; dorsally the pretentorinæ are only slightly removed from the epicranial arms. *Hydropsyche* 27256 has a two-piece gula; the pretentorinæ are further removed. *Hydropsyche incommoda* has only a trace of the caudal piece of the

gula left; the pretentorinæ are no longer associated with the epicranial arms. Thus the modifications of the two sides of the head seem to have been simultaneous and orthogenetic in character.

The small piece wedged into the gular suture in some of the Hydroptilidæ and the Rhyacophilidæ suggests a similar development. The caudal ends in the higher eruciform larvæ also support development from the open type.

Additional evidence could be brought forward in the consideration of the metatentorinæ. In the open type they are always found at the edges of the vertex in the angle formed by the latter and the gula. In the closed type, they are always found at the occipital end of the gular suture, thus furnishing landmarks for the homology of the various structures.

4. *Structure and Position of the Antennæ:* Siltala recognizes two types: one, with a distal segment upon which are mounted two separate so-called palps, and numerous sense bristles; the other with but a single so-called palp. The first form is stated to be common to the campodeiform group, while the second is peculiar to the eruciform group. I have found no trace of antennæ in the Rhyacophilinæ, Philopotamidæ, Polycentropidæ and the Hydropsychidæ.

The antennæ of the Hydroptilidæ are very similar to those of the Leptoceridæ, long, cylindrical and slender, with the palp set on a raised base slightly behind the dorsal mandibular articulation. Exceptionally long antennæ are found in the Œcetinæ, in *Mystacides* and in *Leptocella*. The Molannidæ present the same type and location in antennæ.

In the Phryganeidæ, the antennæ are reduced in size, particularly with respect to the terminal segment. Their position is near the base of the mandibles, but in a more lateral position and separated from the pleural condyle by a pseudo-suture. In the Calamoceratidæ, the antennæ are of the phryganeid type, but are completely removed from the cephalic margin to a position half way up on the head. The Limnophilidæ show the same structure and position of the antennæ.

With respect to this character the Sericostomatidæ show again an interesting developmental series. In the Brachycentrinæ the antennæ are at the cephalic margin; in the Lepidostomatinæ they are halfway between the mandibles and the eyes.

The antennæ are important structures in the consideration of family relationships and receive the best interpretation when we consider the Leptoceridæ as the stem form. Otherwise it is difficult to account for the fact that they are well developed in the Hydroptilidæ, lost in one subfamily of the Rhyacophilidæ, and the other families of the campodeiform group, present again in the Leptoceridæ with greatest functional development, and then consistently reduced in size and migrating up the sides of the head in the remaining eruciform larvæ.

## CONCLUSIONS.

The foregoing pages give a fairly comprehensive description of the head of the trichopterous larvæ. While much detail could be added, those characters of primary importance have been examined and discussed. Before going into the anatomy of the thorax and abdomen, it might be well to sum up the data concerning the head to see if anything like order exists in the relationship of the various parts among the respective families.

The sclerite showing the greatest variation in form is the gula. The two types are the open and the closed. The open type is found primarily in the eruciform group and has its greatest development in the family Leptoceridæ. A graded series of forms is found within the eruciform families which leads from the open to the closed type. The successive steps are from the Leptoceridæ to the Molannidæ, Phryganeidæ, Calomoceratidæ, Limnophilidæ, and the Odontoceridæ. The Sericostomatidæ show a like series within the subfamilies, ranging from an open gula in the Brachycentrinæ to a partially closed one in the Lepidostomatinæ, to a closed one in the Gœrinæ. The closed type is clearly derived from the open. The vertex has come together behind the gula and enclosed it. In some cases the straggling caudal end is still to be seen in the gular suture.

The campodeiform larvæ show, with but few exceptions, the extreme closed type. The method of development of this type is clearly shown in the Hydropsychidæ, where an open gula, a gula constricted into two equal pieces, and a gula constricted into a cephalic part and a minute caudal piece have been demonstrated.

The closed gula of the campodeiform larva is thus brought about by the constriction of the open type into two pieces with the subsequent reduction and disappearance of the caudal piece.

The relationship on the basis of gula would indicate the Leptoceridæ as the stem form, with the higher eruciform larvæ diverging in one direction through the enclosure of the gula by confinement, while the campodeiform larvæ vary in the same direction in the enclosure of the gula by constriction.

A consideration of the fronto-clypeus lends corroborative evidence to the new arrangement of the families of Trichoptera. The straight-sided simpler types are found in the Leptoceridæ. With the pretentorinæ as anchoring points the epicranial arms have bowed above and below to form a sclerite of graceful contour. The development of the various forms is through the Molannidæ, Phryganeidæ to the Limnophilidæ respectively, thus bearing out the family relationships as established for the gula.

The only family in which the epicranial arms have left the pretentorinæ is the Hydropsychidæ. And in this case we find a very definite correlation between the development of the fronto-clypeus and the gula. In the hydropsychid with the open gula, the pretentorinæ are only slightly removed from the epicranial arms; in the species with the gula constricted into two equal halves the pretentorinæ are further removed from the epicranial arms; in the majority of hydropsychids, where the pretentorinæ would not be associated with the epicranial arms, the gula is restricted to a very small triangular piece at the cephalic end of the gular suture.

The chætotaxy of the fronto-clypeus indicates by itself the same general arrangement as that established for the shape of this sclerite and the shape of the gula.

While the labrum shows nothing so definite in its development as do the fronto-clypeus and gula, yet all the positive evidence would favor the new arrangement. It is in the higher campodeiform larvæ that the most highly specialized, asymmetrical labra exist.

The mandibles also have undergone little change. Two types, however, are distinct. The thin, flat, knife-shaped type is characteristic of the Leptoceridæ, Molannidæ, Phryganeidæ and most of the campodeiform larvæ. The thick, blunt, chisel-shaped type is found in the eruciform larvæ.

The labium, while it has undergone little change in special development, shows a consistent and verifying plan in the chitinization

of the submentum. The two bristles, constantly present, leave no doubt as to the identity of the plate. From a condition of no chitinization in the Leptoceridæ to one in which small plates are laid down at the base of the setæ in the higher eruciform, further chitinization produces a large single median plate in the campodeiform larvæ. This reaches its highest development in the bilobed plate in the Hydropsychidæ.

The maxillæ, while giving little in the way of positive evidence, present no difficulties for the new arrangement of trichopterous genealogy. The maxillary palpi are five-segmented throughout with the exception of the Leptoceridæ. The latter, together with the campodeiform larvæ, possess long slender, flexible, maxillary palpi, while those of the eruciform larvæ are short, blunt and heavily chitinized.

The position of the eye supports the new arrangement. The eyes are far cephalad in the Leptoceridæ. The movement in the eruciform larvæ is away from, while in the campodeiform larvæ it is towards, the cephalic margin of the head. This is doubtless correlated with the respective attitudes of the head in the two groups.

The position of the antennæ lends further evidence of the same kind. In the Leptoceridæ they are in a cephalic position, gradually retreating caudad on the head, a movement doubtless correlated with the migration of the eyes in the higher eruciform larvæ. When present in the campodeiform larvæ they are far cephalad. The position of the antennæ becomes of primary importance when their origin is considered. They arise as appendages of the premandibular segment. In their embryological development, the earlier stages are adjacent to the bases of the mandibles. This would indicate a generalized condition, while that away from the mandible would be specialized. The embryological studies of Patten on *Neophylax,* a Limnophilid, show the migration of the antennæ from a cephalic to a lateral position.

All these data taken together favor the assumption that the Leptoceridæ are the stem form, with two principal lines of development, the eruciform and the campodeiform types. The Hydroptilidæ are a very early offshoot and not directly related to the campodeiform type with which they are ordinarily associated.

If this hypothesis be correct, we should expect to find some degree

of correlation in the development of the structures of the thorax and the abdomen. This study has been made and the author hopes to publish the results in a subsequent paper.

## BIBLIOGRAPHY.

FOLSOM, J. W. 1906. Entomology with Reference to its Biological and Economic Aspects.

KRAFKA, JOSEPH, JR. 1915. A Key to the Families of Trichopterous Larvæ. Can. Ent., 47; 217–226.

PATTEN, W. 1884. Development of the Phryganids. Q. J. M. S., 24; 117.

ULMER, GEORG. 1909. Trichoptera in Brauer's Die Süsswasserfauna Deutchlands. Heft 5.

## EXPLANATION OF PLATES.

### PLATE VI.

FIG. 1. *Neuronia postica,* dorsal aspect of the head. *L,* labrum; *Md,* mandible; *LM,* labral membrane; *FC,* fronto-clypeus; *Pl,* vertex; *EA,* epicranial arms; *Pt,* pretentorina; *E,* eye; *A,* antennæ.

FIG. 2. *Neuronia postica,* lateral aspect of head. *Pl,* vertex; *T,* tentorium; *Mx,* maxilla; *Li,* labium.

FIG. 3. *Neuronia postica,* ventral aspect of the head. *Pl,* vertex; *OF,* occipital foramen; *M,* metatentorina; *G,* gula; *Li,* labium.

FIG. 4. *Neuronia postica,* ventral aspect of the labium and maxilla. *G,* gula; *Sm,* sub-mentum; *M,* mentum; *Gl,* glossæ; *Pl,* labial palpus; *C,* cardo; *S,* stipes; *La,* lacina; *PM,* maxillary palpus.

FIG. 5. Leptocerid 26720 (Ill. St. Lab.). Dorsal aspect of head.

FIG. 6. Leptocerid I (Cold Spring Harbor). Dorsal aspect of head.

FIG. 7. Leptocerid III (Cold Spring Harbor). Dorsal aspect of head.

FIG. 8. Leptocerid II (Cold Spring Harbor). Dorsal aspect of head.

FIG. 9. *Mystacides sepulchralis* Walk. Dorsal aspect of head.

FIG. 10. *Molanna cinerea* Hag. Dorsal aspect of head.

FIG. 11. *Molanna* II (Cold Spring Harbor). Dorsal aspect of head.

FIG. 12. *Ganonema americanum* Walk. Dorsal aspect of head.

FIG. 13. *Stenophylax luculentus.* Dorsal aspect of head.

FIG. 14. *Neophylax* sp. Dorsal aspect of head.

FIG. 15. *Psilotreta frontalis* Banks. Dorsal aspect of head.

FIG. 16. Lepidostomatid I (Cold Spring Harbor). Dorsal aspect of head.

FIG. 17. *Gœra* sp.? Dorsal aspect of head.

FIG. 18. *Brachycentrus nigrisoma* Banks. Dorsal aspect of head.

### PLATE VII.

FIG. 19. Hydroptilid II (Cold Spring Harbor, N. Y.). Dorsal aspect of the head.

FIG. 20. *Rhyacophila fuscula* Walk.

FIG. 21. Polycentropid I (Cold Spring Harbor).
FIG. 22. *Phylocentropus* sp.
FIG. 23. Philopotamid 26993 (Ill. St. Lab.).
FIG. 24. Hydropsychid 27006 (Ill. St. Lab.).
FIG. 25. Hydropsychid 27256 (Ill. St. Lab.).
FIG. 26. *Macronema zebratum* Hag.
FIG. 27. *Hydropsyche incommoda.*
FIG. 28. Leptocerid 29451 (Ill. St. Lab.). Enlarged view of the fronto-clypeus to show the details of chætotaxy.
FIG. 29. *Leptocella uwarowii* Kol.
FIG. 30. *Molanna cinerea* Hag.
FIG. 31. Phryganid sp.
FIG. 32. *Ganonema americanum* Walk.
FIG. 33. Lepidostomatid I (Cold Spring Harbor).
FIG. 34. *Anabolia* sp.
FIG. 35. *Psilotreta frontalis* Banks.
FIG. 36. *Brachycentrus* sp. (Cold Spring Harbor).
FIG. 37. Hydroptilid II (Cold Spring Harbor).
FIG. 38. *Rhyacophila fuscula* Walk.
FIG. 39. *Chimarrha* sp. Ithaca.
FIG. 40. Polycentropid 13942 (Ill. St. Lab.).
FIG. 41. *Phylocentropus* sp.
FIG. 42. *Mystrophora americana* Banks.

PLATE VIII.

FIG. 43. Leptocerid 11561 (Ill. St. Lab.). Ventral aspect of the head.
FIG. 44. Leptocerid I (Cold Spring Harbor).
FIG. 45. *Mystacides sepulchralis* Walk.
FIG. 46. *Leptocella uwarowii* Kol.
FIG. 47. Leptocerid II (Cold Spring Harbor).
FIG. 48. *Molanna cinerea* Hagen.
FIG. 49. *Ganonema americanum* Walk.
FIG. 50. *Neophylax* sp.
FIG. 51. Limnophylid 13277 (Ill. St. Lab.).
FIG. 52. *Anabolia bimaculata.*
FIG. 53. *Helicopsyche borealis.*
FIG. 54. *Stenophylax* sp.
FIG. 55. *Psilotreta frontalis* Banks.
FIG. 56. *Gœra pilosa* Fab.
FIG. 57. *Brachycentrus nigrosoma* Banks.
FIG. 58. *Limnephilus indivisus.*
FIG. 59. *Lepidostoma* sp.

PLATE IX.

FIG. 60. Hydroptilid II (Cold Spring Harbor). Ventral aspect of the head.
FIG. 61. *Rhyacophila fuscula* Walk.
FIG. 62. Polycentropid 13942 (Ill. St. Lab.).
FIG. 63. *Chimarrha* sp. (Ithaca).
FIG. 64. *Mystrophora americana* Banks.
FIG. 65. Hydropsychid 27006 (Ill. St. Lab.).
FIG. 66. Hydropsychid 27256 (Ill. St. Lab.).
FIG. 67. *Hydropsyche incommoda.*
FIG. 68. *Macronema zebratum* Hag.
FIG. 69. Leptocerid I (Cold Spring Harbor). Ventral aspect of the labium and maxilla.
FIG. 70. *Leptocella uwarowii* Kol.
FIG. 71. *Molanna cinerea* Hag.
FIG. 72. *Ganeonema americanum* Walk.
FIG. 73. *Psilotreta frontalis* Banks.
FIG. 74. *Brachycentrus nigrosoma* Banks.
FIG. 75. *Arctœcia medialis* Banks.
FIG. 76. Hydroptilid I (Cold Spring Harbor).
FIG. 77. Rhyacophilid I. Tolon, Colo.
FIG. 78. Philopotamid 26993 (Ill. St. Lab.).
FIG. 79. *Mystrophora americana* Banks.
FIG. 80. *Phylocentropus* sp.

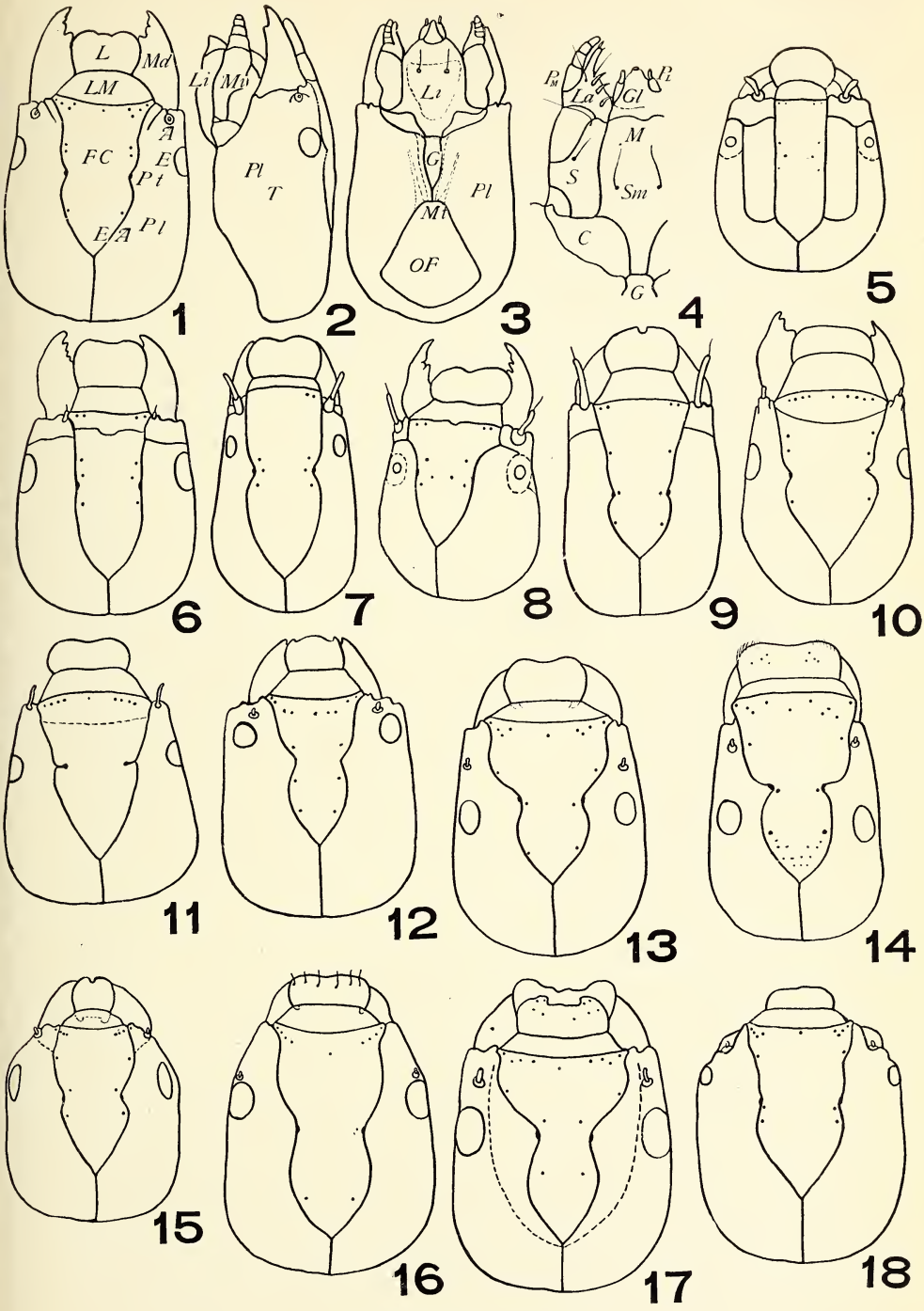
## A NEW WALKING-STICK INSECT FROM EASTERN NORTH AMERICA.

BY WM. T. DAVIS,

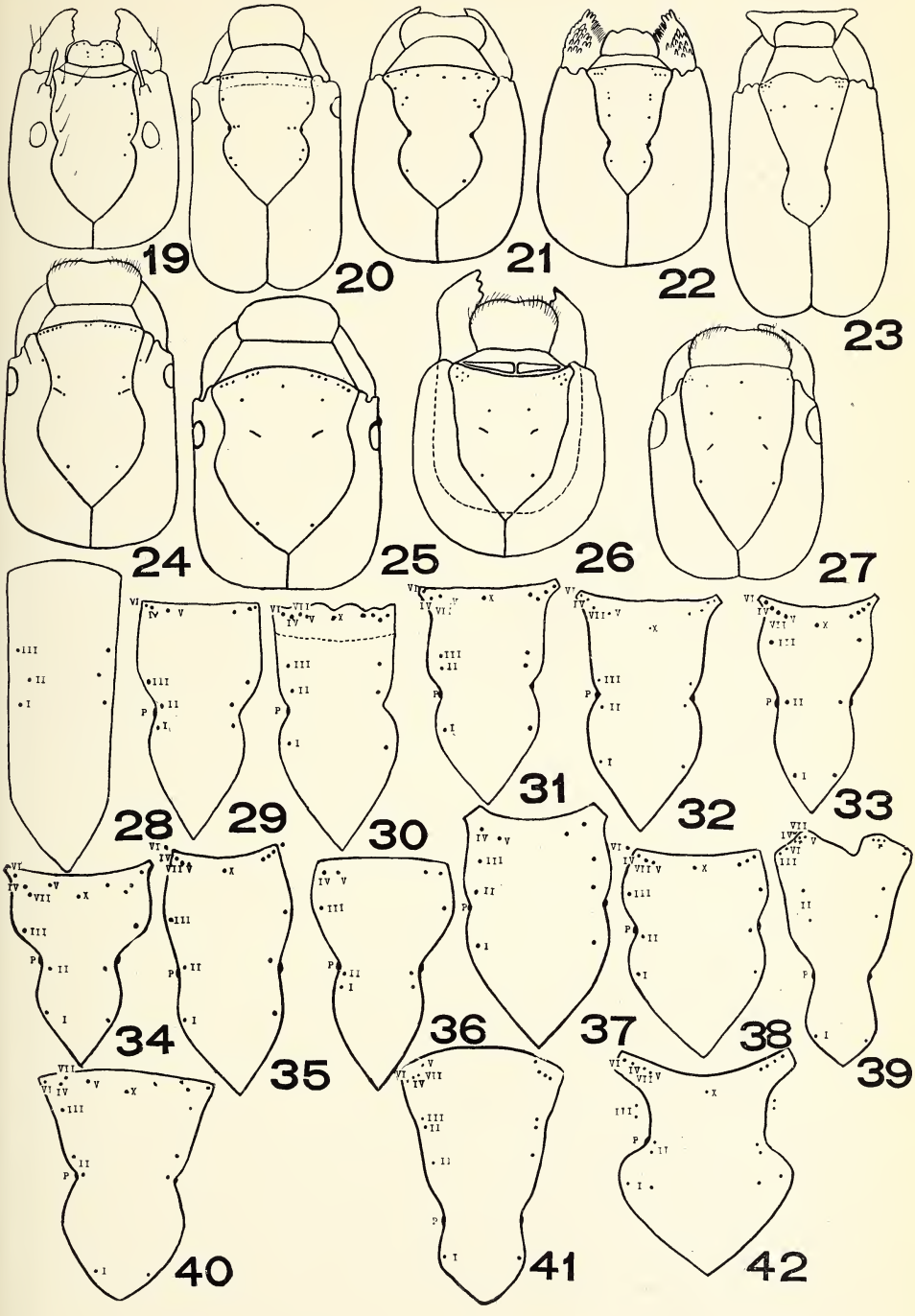
STATEN ISLAND, N. Y.

In the low-lying meadows, and occasionally elsewhere on Staten Island, Long Island, as well as in other localities along the Atlantic coast, there is a walking-stick insect to be found on the golden-rods and associated plants that has interested entomologists for some time. It has passed under the name of *Manomera blatchleyi* (Caudell), but as no males have been recorded, much uncertainty has existed regarding the specific name.

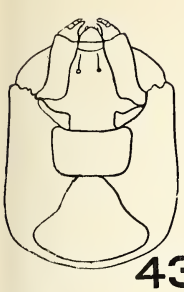
*Bacunculus blatchleyi* Caudell was described in the JOURNAL, New York Entomological Society, Vol. 13, p. 212, 1905, from a male collected in Starke County, Indiana, and according to Mr. Blatchley in

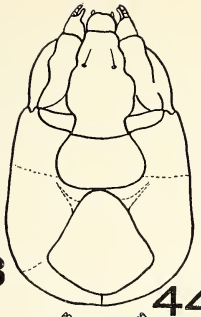


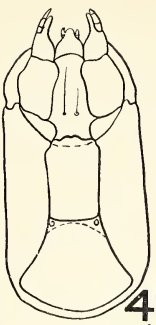

TRICHOPTERA

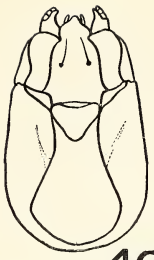


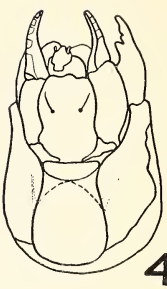

TRICHOPTERA

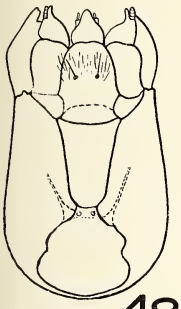

43

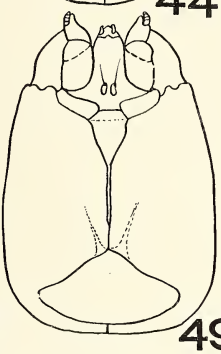

44

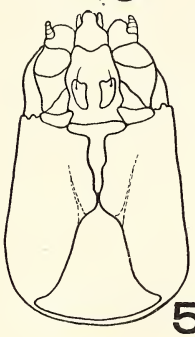

45

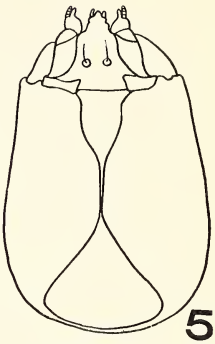

46

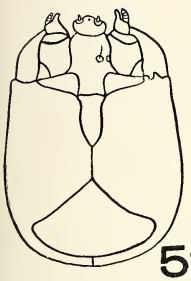

47

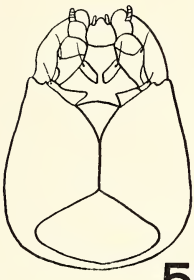

48

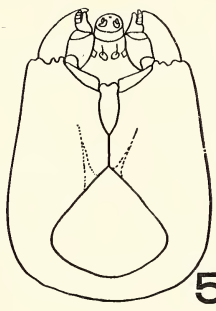

49

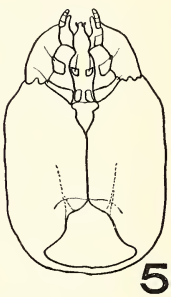

50

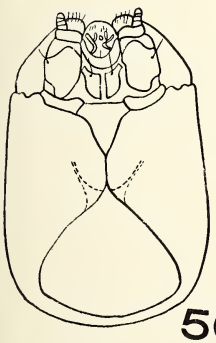

51

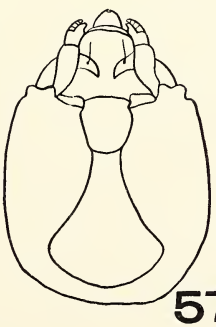

52

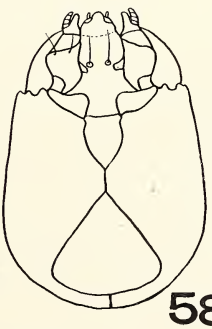

53

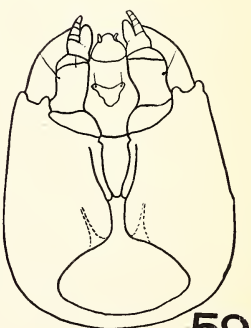

54


55

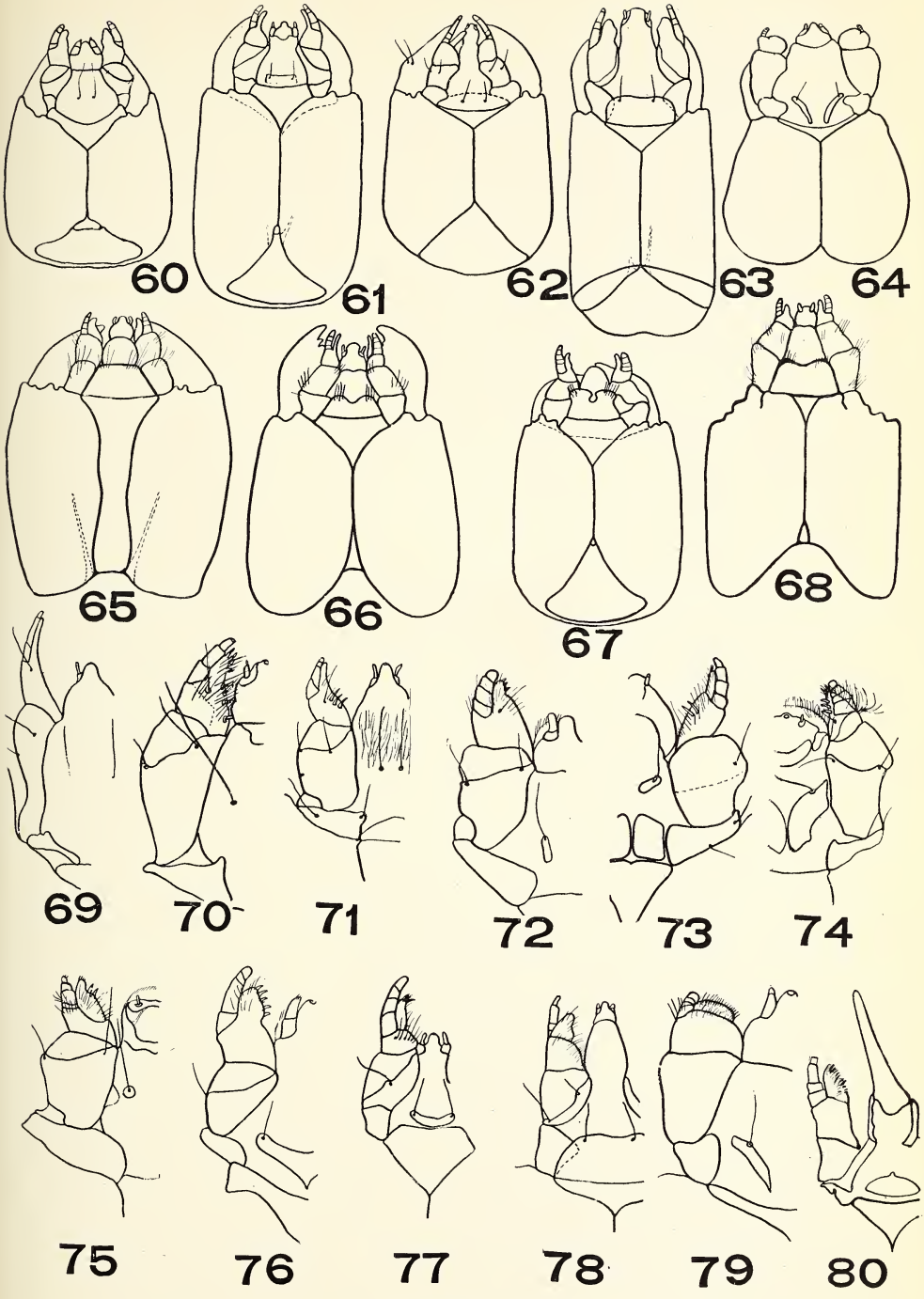

56


57


58


59

TRICHOPTERA




TRICHOPTERA

his Orthoptera of North-Eastern America, has also been found in Missouri, Iowa, Wisconsin, Ohio, and Illinois. Through the kindness of Mr. William J. Gerhard, I long ago received a male and female of this species collected in September at Palos Park, Ill., and in 1922 he sent me an additional female from Palos Park; five females from Argo, Ill., as well as several males from both of these localities.

Comparing the seven females with the forty-six females collected on Staten Island and Long Island, as well as those from other localities along the Atlantic coast, it was noted that they differed in the shape of the head, length of legs and cerci; also in the shape of the sub-genital plate. In the original description is the statement: "Cerci of female rounded and as long as the terminal segment of the abdomen."

On the plate accompanying this article the first four figures represent eastern specimens, while the last four are from photographs of a like number of females sent to me by Mr. Gerhard, which appear to represent the true *blatchleyi,* Fig. 8 having measurements about as given in the original description. The differences shown by these figures are, we think, sufficient to constitute at least a geographic race, and very likely if the male of the eastern form is found, the differences will be still more apparent.

**Manomera blatchleyi atlantica,** new race. Plate X, Figs. 1 to 4.

Resembles *blatchleyi* as described by Caudell and by Blatchley (*loc. cit.*), except that the head in *atlantica* is broader across the eyes and tapers gradually toward the posterior margin, whereas in typical *blatchleyi* the sides of the head are much more nearly parallel. Specimens of the same length, when compared, have the legs in the eastern examples longer and the cerci shorter, than in those from Illinois. The cerci are much shorter than the last abdominal segment in *atlantica,* whereas in *blatchleyi* they are more nearly of the same length. These differences are shown on the accompanying plate. The subgenital plate in *atlantica* has the extremity, as a rule, more evenly rounded than in *blatchleyi,* where it is often quite pointed.

Length of head in female type 3.5; pronotum 3.25; mesonotum 15; metanotum 12; fore femora 18; middle femora 14; hind femora 19; cerci 3 mm.

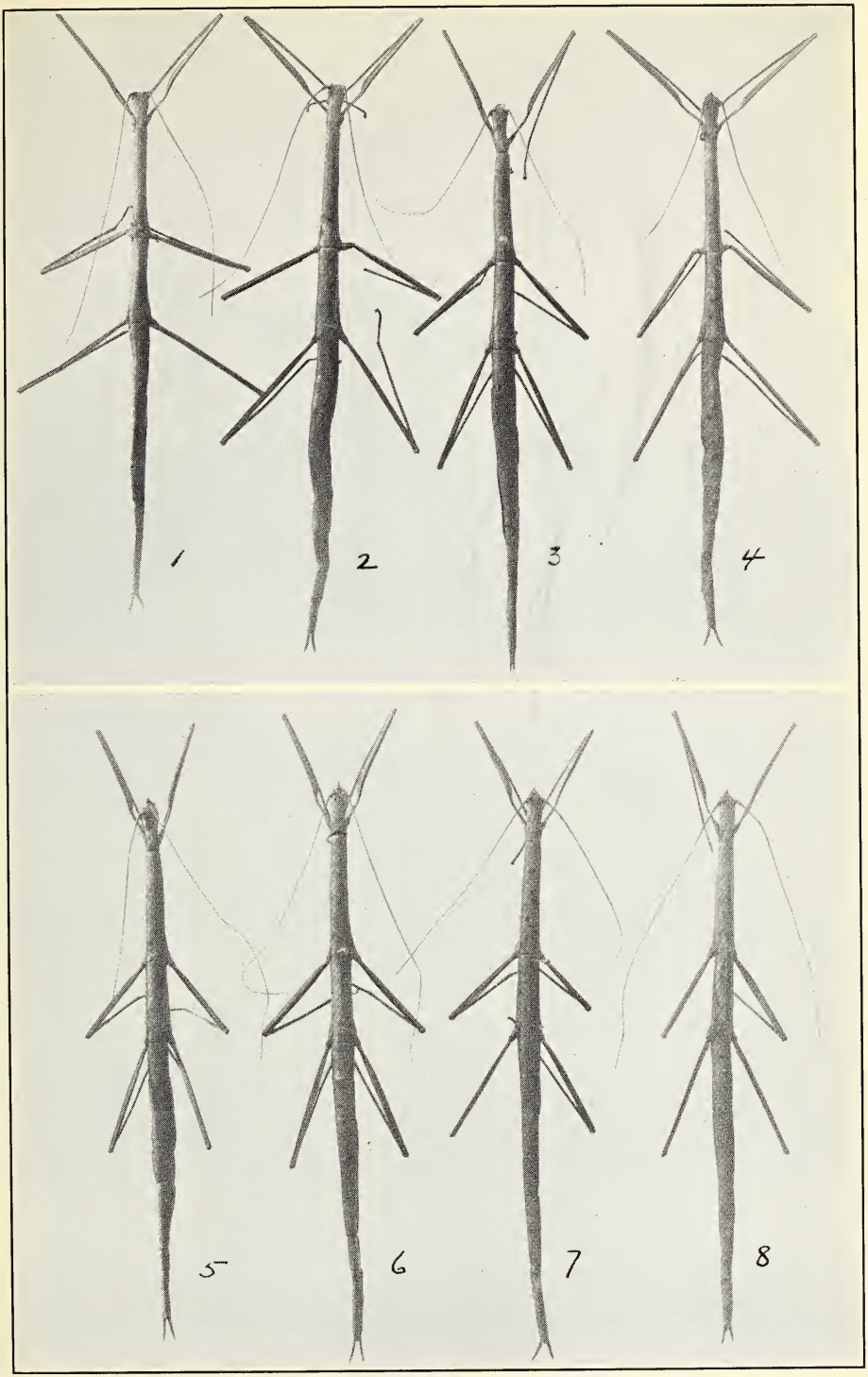
Type female, Clove Valley, Staten Island, N. Y., September 9, 1893. Davis collection.

In addition to the type, three other mature females have been collected on Staten Island, at Richmond Valley, Sept. 23, 1883; Mariners' Harbor, Sept. 26, 1903, and one on August 7 without definite locality. Numerous female nymphs have been found in the Clove Valley, at

Watchogue, and near Richmond, in the months of June, July and August. On Long Island no less than forty-two females have been collected; many more were found but allowed to escape. The greatest number (31) have come from a piece of low-lying ground at Maspeth, where Mr. C. E. Olsen located a flourishing colony in 1912. Here, near the habitations of man, and apparently free from many natural enemies, they were quite numerous. Very often in an hour or two, we could find a dozen or more, usually on *Solidago rugosa,* as well as on other species of golden-rod and associated plants. When additional specimens were needed in 1922, Mr. Frederick M. Schott collected twenty-one females on the afternoon of September 23, and let a few others go. Mr. Olsen, Mr. Schott and I have looked particularly for the male in this locality at several seasons of the year, both by day and night, but thus far without success. Many of the specimens found are green, but they may be grayish, brownish, or even purplish in color. Elsewhere on Long Island females have been collected at Brooklyn, Flushing (E. L. Bell, Dr. W. H. Wiegmann and W. T. Davis), Roslyn, Setauket (G. P. Engelhardt), Sea Cliff, Wading River, River Head, Amityville (Edw. D. Harris), and Blue Point. The dates of capture for mature specimens range from July 30, 1919 (Wading River), to Oct. 1, 1918 (Setauket).

From elsewhere the writer has specimens as follows: New Haven, Conn., Sept. 4, 1911 (C. E. Olsen); Crotona Park, N. Y. City, Oct. 9, 1904 (Frank E. Watson); Paterson, N. J., Aug.; Plainfield, N. J., Oct. 20, 1916 (W. De W. Miller); Keyport, N. J. (no date); Erma, Cape May Co., N. J., August, 1912, 10 females; Dyke, Va., July 18, 1913 (Davis), and Vienna, Va., Aug., 1918 (H. G. Barber).

The only other species of walking-stick insect found in the northeastern states is *Diapheromera femorata* (Say). It has not been collected on Staten Island, but on Shelter Island (Long Island) it was quite common a number of years ago according to Mr. Adolph W. Callisen. In the fall of 1922 Mr. Roy Latham found a number at Orient, Long Island. Elsewhere on the neighboring mainland, it is often quite common, feeding on a number of trees and bushes, but it is not as a rule found on herbaceous plants, as is *Manomera atlantica.*




MANOMERA

EXPLANATION OF PLATE.

FIG. 1. *Manomera blatchleyi atlantica.* Type. Clove Valley, Staten Island.

FIG. 2. *Manomera blatchleyi atlantica.* Richmond Valley, Staten Island.

FIG. 3. *Manomera blatchleyi atlantica.* Maspeth, Long Island.

FIG. 4. *Manomera blatchleyi atlantica.* Vienna, Virginia.

FIGS. 5–8. *Manomera blatchleyi.* Argo, Illinois.

# PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

## MEETING OF MAY 17.[1]

A regular meeting of the New York Entomological Society was held at 8 P.M., on May 17, 1921, in the American Museum of Natural History, Vice-president Harry B. Weiss in the chair with 21 members and 1 visitor present.

Mr. Woodruff made an exhibition of "Insects collected in Alabama," saying that most of the material was collected after April 1, when the season seemed to open suddenly. The membracids were discussed at length, especially in regard to their sexual characters. The locality visited was Hazen, about 70 miles southwest of Montgomery.

Mr. Bell read a paper, "Notes on Florida Collecting," descriptive of 26 warm, rainless days and cool nights spent near Tampa and Gulfport, during which 64 species of butterflies were found.

Dr. Bequaert reviewed the chapters on Mimetic Butterflies in Carpenter's "A Naturalist on Lake Victoria" giving incidentally a general discussion of mimicry, the conflicting views of various authors and his own experiences in Africa.

## MEETING OF OCT. 3.

A regular meeting of the New York Entomological Society was held at 8 P.M., on October 3, 1922, in the American Museum of Natural History. President John D. Sherman, Jr., in the chair with 18 members and two visitors present.

A minute recording the death of Silas C. Wheat and the regret of his fellow members was ordered.

Mr. Wm. T. Davis exhibited a specimen of *Xylotrechus aceris* Fisher, taken at St. George, Staten Island, in July, 1921. This species was described in the Proceedings of the Entomological Society of Washington, 1916, from specimens collected in Washington, District of Columbia; also from Delaware, Kentucky, and Pennsylvania. It is said to be "closely allied to *quadrimaculatus* Hald., from which it differs by having the four spots on the thorax of sparse white pubescence instead of dense yellow pubescence, by having the

[1] Meeting of May 17, 1921, omitted by accident.

antennæ shorter, and also by its habit of making galls on maple trees, while *quadrimaculatus* girdles the branches of various trees similarly to *Elaphidion villosum* Fabr."

Mr. Angell recorded finding the green form of *Cicindela tranquebarica* at Yonkers, May 21, *Necrophilus pettiti* at Cooks Falls, Delaware Co., N. Y., on September 25, *Dytiscus harrisi* at East Branch, N. Y., on July 29, and about 30 specimens of *Myas cyanescens* at Montauk, Long Island, on August 27.

Mr. Olsen recorded a pink form of the Fulgorid *Amphiscepa bivittata* at Ulster Park.

Mr. Hall spoke of a Lakehurst trip with Mr. Woodruff, of a trip to the Peninsula of Maryland with Mr. Jones, of another to Mt. Desert and of six days in the island of Newfoundland—of the latter more details will be given on October 17.

Mr. Bell showed specimens of *Astyanax* form *albo-fasciata* Newcomb.

Dr. Lutz referred briefly to his experiences in Colorado, showing pictures of Long's Peak and praising the automobile that carried him there and back.

Dr. Bequaert spoke of his visit to his relatives in Europe and of the Museums he had visited in Paris, Brussels and London, where he had been able to examine many types. He showed some of the Guides and sets of cards relating to insects he had obtained at the British Museum and the famous early work of Meigen on Diptera, which he had obtained from L. Bedel's library, and of which only three copies are known. Dr. Bequaert also exhibited the current number of "Hobbies" devoted largely to the collection of the late Dr. E. G. Love, now owned by the Buffalo Society of Natural History. He also exhibited and described in some detail *Triatoma rubromaculata* referring especially to their domesticated habits and function in carrying disease. Their usefulness also in diagnosing certain diseases from the rapidity with which they become infected with Trypanosomes was pointed out.

Mr. Shoemaker spoke of trips to Wading River with Messrs. Davis and Schaeffer, to Montclair with Messrs. Quirsfeld and Nicolay and to the Catskill Mts. where he had found a *Saperda* possibly new, and other rare and interesting moths and beetles.

Mr. Barber had spent most of the summer near Washington, D. C., with good results; a Ceratocomid obtained by sifting, *Leptostyla oblonga* and other species were mentioned. A special study of the genus *Triatoma* had been made and will be spoken of at a later meeting.

Mr. Dickerson had also been active. Monmouth Junction with Weiss; Berkeley Hts. with Bischoff; Lakehurst with Messrs. West, Davis, and Barber were among his exploits. At Hackettstown he had collected leaf hoppers successfully in low pasture grass and at Glenwood Lake had had other successes.

Mr. Lesieski reported finding a red form of *Cicindela generosa* in New Jersey.

Mr. Levine had wandered as far as Mexico.

Mr. Schwarz had to report on Bermuda, where he had found Monarch butterflies, cicadas, honey bees, and other introduced insects in plenty, but wild bees and Sphingids scarce.

Mr. Davis said the Bermuda *Tibicen bermudiana* greatly resembled our lyricin; and that the great number of Monarch butterflies was only a return to normal conditions, the scarcity for a few years following the cold winter of 1917–1918 being a temporary condition. He also described Mr. Shoemaker's devotion to science as exemplified by his bleeding legs after he had waded into Long Pond to catch Donacias and got leeches as well.

Mr. Sherman closed the evening with an interesting account of his northern wanderings, which included a visit to Mr. Notman at Keene Valley, and the ascent of Mt. Marcy; two weeks in Canada with Chagnon, Swaine, McDonough and others; White Mts., Lake Champlain, and Vermont. Among the entomological results were the acquisition of a set of Le Naturaliste Canadien, a view of the Provencher collection and the resolution to print a paper on *Agabus,* inspired by Fall's publication of *Hydroporus.* Mr. Sherman closed his share of the evening by exhibiting a petition dated August 22, 1873, found in the Uhler correspondence signed by Dr. Leconte and many other famous entomologists of that date.

### Meeting of October 17.

A regular meeting of the New York Entomological Society was held at 8 P.M., in the American Museum of Natural History. President John D. Sherman, Jr., in the chair with 16 members and 6 visitors, including Messrs. Edgar Nelson, Arnold Seigel and Louis Eisman, present.

The president, with great sorrow, announced the death of L. R. Reynolds, aged 44. Mr. Reynolds, famous for his work on *Omus* in California, had lived for some years in Mexico, and traveled lately in Venezuela and Trinidad. Though apparently robust, he had really been in poor health for some years; illness necessitated his return to his home near Boston, where he died on October 9. The secretary was instructed to express the regret and condolence of the Society by letter to Mrs. Reynolds.

Mr. Hall exhibited "Some Newfoundland Butterflies," and in describing them spoke of his arrival at Port aux Basques on July 26, when snow still lingered on the mountains, and of the opportunity he had on account of a train accident of collecting lowland forms soon after. *Eurymus interior, Argynnis atlantis, Phyciodes tharos, Heodes epixanthe,* and *Polites peckius* were shown. At Port au Port he found the tree line at 600 feet elevation and obtained *Eurymus pelidne* and *Plebius aquilo.* General collecting about Port au Port yielded a sight of two species of *Papilio* and specimens of *Brenthis myrina.* The strong wind in elevated localities made the use of a very light net with stick of balsam wood desirable. His remarks were discussed by Messrs. Engelhardt and Leng. Mr. Englehardt described the fierce wind blowing in from the bay at Port au Port, causing the sprawling spruces upon whose branches one could walk; also the beauty of the orchids of the lowland bogs. As to

*Papilio brevicauda;* he said adults were scarce in late July and August but larvæ were to be found feeding on wild parsnip. He had taken a number home, from which about two dozen adults were later bred. He also spoke of the night collecting at George's Pond as remarkably good.

Dr. Bequaert spoke at length under the title "Further Considerations upon the Color Variations of Wasps, as illustrated by the genus *Synagris*" using three boxes of specimens as illustrations, together with a map of Africa, on which the range of the species was indicated and a color plate which he had already published. In his remarks were also embodied the results of studies at the British Museum, which covered practically all the known species of the genus *Synagris*. He said that he did not mean his remarks to be understood as applying beyond the wasps referred to but in those it was very plain that considerable variation in color not correlated with variation in structure was observable, and that a uniform type of color was often found in widely differing species. 12 color forms of *Eumenes maxillosus* and many forms of *Synagris cornuta* were used to illustrate the first rule and 15 species all black with orange tip to the abdomen were used to illustrate the second rule. After discussing the relative value of color and structure in taxonomy, the bearing of distribution upon the problem, the treatment it had received from ornithologists and other students, Dr. Bequaert came to a discussion of the way in which such color variations had arisen. The various theories that have been advanced were each considered, leading finally to the conclusion that we do not as yet know as much about color as we do about structure, especially respecting the factors producing it. His remarks were followed with close attention and were discussed by Messrs. Notman, Engelhardt, and Leng.

Mr. Notman exhibited an unusual Monarch butterfly, in which the right-hand wings were much smaller than the left-hand wings. Notwithstanding this crippled condition, the butterfly had flown into Mr. Notman's window.

Mr. Wm. T. Davis exhibited a female *Megaphasma dentricus* (Stol) measuring 160 mm. in length, and stated that it was the largest species of walking-stick insect so far found within the limits of the United States. The specimen was collected at Neshoba, Mississippi, July 6, 1922, by J. G. Hallford, and received through the courtesy of Professor R. W. Harned.

# JOURNAL

OF THE

# New York Entomological Society.

Published quarterly by the Society, at Prince & Lemon Sts., Lancaster, Pa., and New York City. All communications relating to the JOURNAL should be sent to the Publication Committee, New York Entomological Society, American Museum of Natural History, New York City; all subscriptions to the Treasurer, Wm. T. Davis, 146 Stuyvesant Place, New Brighton Staten Is., New York, and all books and pamphlets to the Librarian, Frank E. Watson, American Museum of Natural History, New York City. Terms for subscription, $2.00 per year, strictly in advance. ***Please make all checks, money-orders, or drafts payable to NEW YORK ENTOMOLOGICAL SOCIETY***

Authors of each contribution to the JOURNAL shall be entitled to 25 separates of such contribution without change of form. If a larger number be desired they will be supplied at the following rates, provided notice is sent to the Publication Committee before the page proof has been corrected:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8¢ | for each reprint of a | | | 1 | to | 4 | pp. | article. |
| 10¢ | " | " | " | " | 5 | " 8 | " | " |
| 12¢ | " | " | " | " | 9 | " 12 | " | " |
| 16¢ | " | " | " | " | 13 | " 16 | " | " |
| 20¢ | " | " | " | " | 17 | " 20 | " | " |
| 24¢ | " | " | " | " | 21 | " 24 | " | " |
| 26¢ | " | " | " | " | 25 | " 28 | " | " |
| 28¢ | " | " | " | " | 29 | " 32 | " | " |

Two cents additional for each half-tone print. Covers on same paper as the JOURNAL, with printed title page, $1.50 for 50 covers, and 2 cents for each additional cover.

# THE NEW YORK ENTOMOLOGICAL SOCIETY

Organized June 29, 1892.—Incorporated June 7, 1893.

---

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Eighth Ave.

Annual dues for Active Members, $3.00.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

---

## Officers for the Year 1923

*President*, HARRY B. WEISS ..... 19 N. 7th Ave., New Brunswick, N. J.

*Vice-President*, FRANK E. LUTZ ..... American Museum of Natural History, New York.

*Secretary*, CHAS. W. LENG ..... Staten Island Museum, St. George, S. I., N. Y.

*Treasurer*, WM. T. DAVIS ..... 146 Stuyvesant Place, New Brighton, Staten Island, N. Y.

*Librarian*, FRANK E. WATSON ..... American Museum of Natural History, New York.

*Curator*, A. J. MUTCHLER ..... American Museum of Natural History, New York

*EXECUTIVE COMMITTEE*

H. G. BARBER, GEO. P. ENGELHARDT, L. B. WOODRUFF.
JOS. BEQUAERT, G. C. HALL.

*PUBLICATION COMMITTEE.*

J. D. SHERMAN, JR. E. L. DICKERSON, HOWARD NOTMAN,
C. E. OLSEN.

*AUDITING COMMITTEE.*

E. SHOEMAKER, E. L. BELL, A. S. NICOLAY

*FIELD COMMITTEE.*

A. S. NICOLAY, JOS. BEQUAERT.

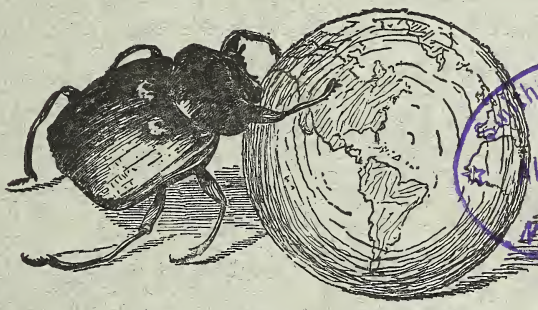
*DELEGATE TO THE N. Y. ACADEMY OF SCIENCES.*

WILLIAM T. DAVIS.

Vol. XXXI. June, 1923 No. 2

# JOURNAL OF THE New York Entomological Society

Devoted to Entomology in General





JUNE, 1923

Edited by HOWARD NOTMAN

*Publication Committee*

HOWARD NOTMAN J. D. SHERMAN, JR.
E. L. DICKERSON C. E. OLSEN

Published Quarterly by the Society.

LANCASTER, PA. NEW YORK CITY

1923

(Entered April 21, 1904, at Lancaster, Pa., as second-class matter under Act of Congress of July 16, 1894.)

LANCASTER PRESS, INC.

## CONTENTS



**NOTICE**:—Volume XXXI, Number 1 of the Journal of the New York Entomological Society was published on March 20th, 1923.

JOURNAL

OF THE

New York Entomological Society.

Vol. XXXI. June, 1923. No. 2

# THE GROUP TRACHES IN NORTH AMERICA. PART II[1]. THE GENUS BRACHYS (COLEOPTERA).

By Alan S. Nicolay and Harry B. Weiss,

New Brunswick, N. J.

**Brachys** Solier, 33–312.

Broadly ovate, triangular in form; scutellum small, triangular, surface glabrous, very variable, flat to concave, or with a transverse carina, such variations occurring in large series of the same species; thorax widest and transversely depressed at the base; front convex, hind angles with a distinct carina, eyes convex; head longitudinally impressed with a more or less distinct glabrous tubercle above each eye; antennæ very short and inconspicuous, received in distinct grooves on the under side of the thorax near the margins, 11-jointed, first two joints largely inflated, next three small suboval, last six serrate; elytra rather irregularly punctured and with a distinct lateral carina reaching almost to the apex which is pectinate, two other carinæ on elytra shorter and less distinct (carinæ interrupted or entirely wanting in certain Central American species); elytra concave along margins behind shoulders, sides sinuate to about apical half thence narrowed toward apex; entire dorsal surface with more or less pubescence arranged in rather distinct sinuate fasciæ on elytra; legs retractile, tibiæ linear, last tarsal joint as long as first four combined; prosternum obtuse behind; ventral surface smooth to very finely punctulate, ventral segments rather convex with short sparse pubes-

[1] Continued from Jour. N. Y. Ent. Soc., Vol. XXVIII, No. 2, 1920, pp. 136–150. Part I, The Genera *Pachyschelus* and *Taphrocerus*.

cence arranged in somewhat transverse lines, last ventral segment of females in some species with a deep emargination and with long fimbriate hairs along emargination. Our species are black, usually with a metallic lustre.

Despite the great variations in size and color of some of our commonest species we do not feel that the erection of any new species is warranted. In a limited collection containing but few examples, the extremes could be easily separated into valid species but upon assembling a larger series innumerable intergrading individuals would make the task difficult and cause no end of trouble for future students. Even with the present eight well-defined species and three varieties, the construction of a workable key was rather difficult and as all of our forms possess the distinct lateral carina[1] of the elytra, we are forced to base one division solely on the sexual characters of the females which fortunately for this purpose at least, appear to far outnumber the males.

The genus is rich in specimens if not species and its members occur in all of our Eastern States from Canada through Florida and out west from Edmonton, Alberta to Texas, Arizona, thence through Central America to Brazil and Peru. Strange to say the Pacific Coast States appear to be without a single representative.

Comparatively little is known of the life histories of the members of the genus although it is quite probable that most of them are leaf-miners in their larval stages and leaf-feeders as adults. In the literature the habits of *Brachys ovatus* and *Brachys ærosus* have been referred to briefly by Packard, Riley, Gillette, Felt, Blatchley, Burke, Knull and others. In New Jersey we have observed *Brachys ovatus* feeding on the foliage of elm, sugar maple, white oak, chestnut oak, pin oak, scrub oak, black oak, post oak, chestnut, beech and hickory with the oaks as preferred food plants and *Brachys ærosus* feeding on beech, linden witch hazel, elm, chestnut, sugar maple, red maple and various species of oaks with the oaks as preferred food plants. The feeding of both species is similar and quite characteristic, the tissue between the larger veins of the leaves being consumed. This results in the injured portion having a somewhat ragged, geometrical appearance.

[1] The key in Biol. Cent. Amer., Vol. III, Part I, p. 131, separates the species by the lateral carina being continuous, interrupted or entirely wanting.

The eggs resemble drops of transparent, watery excrement, being very flat, oval and rounded at both ends. They are deposited as a rule on the upper leaf surface many of them close to the margins. The young larvæ enter the leaf tissue directly beneath the eggs and mine the tissue in irregular areas around the eggs or in gradually widening, elongate areas away from the eggs and somewhat parallel to and against the leaf edges. Many mines are blotch-like and while they may occur on any portion of a leaf, most of them are located near the edges. As a rule each mine contains only one larva and is found on a leaf which is comparatively uninjured by adult feeding. The mines are visible on both leaf surfaces more so on the upper where they appear as brown, dead spots or areas. On large trees only the outer leaves which are exposed to plenty of sunlight appear to be mined or fed upon. Most of the mines occur on oak foliage in spite of the fact that the leaves of many other trees are used as food by the beetles. After becoming full grown, the larvæ leave the mines and pupate on or slightly under the surface of the ground.

The larvæ of both *ovatus* and *ærosus* are slightly wedge-shaped and much flattened. The body is composed of thirteen well-defined segments and is deeply notched or lobed. The head and mouth parts are dark and the head is more or less retracted into the first segment. The first segment is as broad or slightly broader than the following ones, the body gradually tapering posteriorly. The first segment bears a large well-developed, somewhat smooth, shining, subquadrate plate on both dorsal and ventral surfaces, the dorsal plate having a median line groove. The first seven abdominal segments are produced laterally into pronounced, rounded lobes and the lobes of the fifth to ninth segments each bear a group of several stout, minute spines. The posterior edge of the eighth abdominal segment is fringed with a row of minute, stout spines. The color of the larva is whitish with head and mouth parts dark and a broad, median, dorsal, abdominal line is indicated on segments one to eight. Both eggs and larvæ are parasitized by the larvæ of *Closterocerus cinctipennis* Ash.

### Key to the Species of Brachys.

1. Tubercle above the eye very prominent, convex, and extended when viewed laterally; apical half of elytra sometimes with a tuft of black and ferrugineous hairs.....2.

   Tubercle above the eye not at all prominent or extended; apical half of elytra never with a tuft of hairs.....3.

2. Elytra each with a distinct tuft of black and ferrugineous hairs; tubercle moderately prominent and extended; length, 5–5.5 mm.
**floccosus** Mannerheim.

Elytra without a tuft of hairs; tubercle greatly extended and prominent; length, 4–4.5 mm.....**cephalicus** Schaeffer.

3. Last ventral segment of female deeply emarginate with long, fimbriate hairs along emargination; elytra usually with three or more narrow, sinuate white fasciæ.....4.

Last ventral segment truncate or rounded in both sexes; elytra without three sinuate, narrow, white fasciæ.....8.

4. Steel blue; pubescence whitish, arranged in narrow, sinuate fascia.
**tessellatus** Fabricius.

Pubescence denser, golden silvery or ferrugineous bordered by narrow white fasciæ.....5.

5. Vestiture very dense, form broad, punctuation of elytra coarse and regular .....6.

Vestiture not so dense; form usually more narrow; punctuation of elytra shallow and uneven, apical half of elytra with broad, glabrous, transverse space.....7.

6. Pubescence ferrugineous bordered by narrow white fasciæ.
**floricola** Kerremans.

Pubescence entirely light golden to silvery.
**floricola** var. **blatchleyi** new variety.

7. Pubescence ferrugineous bordered by narrow white fasciæ or maculæ.
**ovatus** Weber.

Pubescence entirely light golden to silvery.
**ovatus** var. **bellporti** new variety.

8. Black; elytra with a single, broad, white fascia just behind the centre; last ventral segment broadly rounded.....**fasciferus** Schwarz.

Metallic; elytra without single, broad white fascia; last ventral segment not noticeably broadly rounded.....9.

9. Pubescence gray to fulvous or yellowish, generally bicolored; elytra usually blue sometimes blackish or with æneous or purplish lustre; length, 3–5.75 mm.....**ærosus** Melsheimer.

Pubescence brilliant cupreous to ferrugineous; elytra usually cupreous or brassy.....**ærosus** var. **rufescens** new variety.

Pubescence dense, uniformly light golden to silvery; elytra black often with æneous lustre; length, 3–3.75 mm.....**æruginosus** Gory.

**Brachys floccosus** Mannerheim, 37–118 (Plate XI, fig. 1).

(Translation of original description.)

"Short ovate, obscure glittering-violaceous bronze, head excavated 4-nodulose, base of thorax strongly dilated, variegated with griseous and fulvous, sides of elytra costate striate-punctate, base densely

whitish pubescent from there variegated with black and griseous pubescence, separatel a little behind middle into two bands, pubescence at base orange, at apex black. Mexico: Oaxaca Longit. 5 mm. Latit. 3 mm.

"Head deflexed, front excavated variegated with griseous and orange pubescence, with a pair of small shining nodules, vertex globose, binodulate, largest tubercle less elevated. Antennæ shorter than head and thorax together, cupreous. Thorax short, front twice as narrow as base, sides scarcely rounded, base deeply trisinuate, median lobe strongly produced, above roundly elevated, posteriorly transversely depressed, variegated with griseous fulvous and blackish pubescence. Scutellum triangular, obscure violaceous. Elytra at base as broad as thorax and three times longer than the same, humeri straight prominent, sides from there on almost straight, feebly margined, gradually narrowed a little behind the middle on both sides, carinate from humeri to beyond middle, carina curved inwardly, remotely striate-punctate, anterior third entirely thickly whitish-pubescent from there on variegated with black, griseous and fulvous pubescence, separated a little behind the middle into two obliquely placed bands, pubescence orange at base, black at apex and behind that near apex two whitish pubescent bands, outwardly orange. Ventral surface with feet violaceous-cupreous punctulate."

Ovate. Elytra usually steel-blue, rather gradually narrowed toward the apex, pubescence dense, white, forming an indistinct subbasal fascia bordered with brownish pubescence along the margins which becomes more conspicuous and predominates toward the tips of the elytra; a distinct tuft of black and ferrugineous hairs at about apical two-fifths. Thorax, head and ventral surface æneous; a distinct rather bare tubercle above each eye. Last ventral segment broadly truncate, segments punctulate with short, sparse, silvery pubescence. Length 5–5.5 mm.

*Localities.*—Chirique Mts., January 6 (Hubbard and Schwarz); Huachuca Mts., July 11 (Schaeffer, Wenzel, Biedeman); Arizona. Oaxaca, Juquila, Parada (Salle); Mexico. San Geronimo, Capetillo, Cerro Zunil 4000 feet (Champion): Guatemala.

This Central American form is the most beautiful and bizarre of all our species. Its large size, distinct tufts of hairs near the tips of

the elytra and broadly truncate ventral segment at once separate it from all of our other species. On oak (Schaeffer).

**Brachys cephalicus** Schaeffer, 09–377 (Plate XI, fig. 2).

(Original description.)

"Head strongly convex above the eyes and deeply, longitudinally impressed at middle, giving this part the appearance of two large tuberculiform elevations; between the eyes are two similar, but smaller elevations; surface not very densely clothed with golden pubescence; sculpture rather reticulate. Thorax æneous, clothed not densely, with golden pubescence; disk smooth, the basal impressions and at apex with large, somewhat ocellate punctures. Elytra as in *ovatus* Web., but the markings towards apex more ferruginous and golden than in that species. Underside black; surface sculpture very finely reticulate, sparsely intermixed with semicircular impressions, each of which gives rise to a single white hair; apex of abdomen coarsely toothed. Length 4 mm. Huachuca Mts., Arizona..

"Readily known from any of the North American species by the head above the eyes more strongly convex than in *floricola* and *fascifera* and by the relatively longer thorax." ..

*Localities.*—Huachuca Mts. (Schaeffer), "Arizona" (Horn Coll.); ARIZONA.

Very closely related to preceding from which it may be readily separated by the absence of tufts of hair near elytral apices, smaller and narrower size, very prominent tubercle above each eye (which easily distinguishes it from all of the following species) (see figure 2), and the golden pubescence of the thorax, base and tips of the elytra; the rarest of our North American *Brachys* and represented in but few collections. Up to the present Arizona is the only state in which *cephalicus* has been found. In the Horn collection at the Academy in Philadelphia there is a small series bearing the manuscript name *frontosa* Blanchard, all marked males and with only the state label.

**Brachys tessellatus** (Fabricius), 01–218 (Plate XI, fig. 6).
*lugubris* Le Conte, 59–251.

(Translation of original description.)

"*Trachys.* palpi four very short, equal. Maxilla bifid. Antennæ moniliform.

"*Tesselate.* I. T. black elytra whitish tesselate. Habitat in Carolina. Mus. D. Bosc. Mouth with maxillæ and palpi. Palpi four very short, equal, filiform, anterior ones scarcely longer four jointed; joints subequal adherent to upper surface of maxillæ, posterior ones three-jointed; joints equal, growing from the external-centre of the ligula. Mandibles short, corneous without teeth, acute. four, very short, equal, filiform, anterior ones, scarcely longer, Maxillæ membraneous, bifid; fringe equal, obtuse. Ligula short, membraneous, entire. Labium short, corneous, transverse, entire.

"Larger than *T. pygmæa.* Color of head and thorax variable varying from black to obscure aurulate. Elytra substriate often concolorous, whitish-tesselate. Body black, shining."

Broadly ovate, slightly sinuate from shoulder to about apical half thence rather gradually narrowing toward apices of elytra. Shining black to steel-blue in color. Elytra unevenly punctate striate, lateral carina prominent reaching almost to apex, median one less distinct and almost joining lateral carina toward apex, sutural carina rather vague, shorter and interrupted near middle; pubescence whitish to dirty gray, arranged in three irregular, sinuate, transverse fasciæ, which when closely examined are seen to be formed by distinct, individual spots of pubescence; slightly concave behind shoulders which are prominent, tips pectinate, rather truncate. Scutellum large, transverse, not noticeably punctate. Thorax deeply, transversely depressed and widened at base, smooth to very minutely granulate, pubescence along margins becoming sparser toward centre. Head with deep longitudinal impression, rather concave, pubescent. Eyes prominent. Ventral surface steel-blue to æneous or blackish, ventral segments granulate with very short, sparse, whitish, transverse pubescence, last ventral segment of the female deeply emarginate with long golden to silvery hairs along the emargination, male segment rather broadly rounded without hairs, last dorsal segment pectinate in both sexes. Length 4.5–6 mm.

*Localities.*—Tampa, April 10, Jacksonville, Crescent City (Hubbard and Schwarz); Key West, Lake Mary (Frost and Nicolay collections); Florida. Texas. Wilmington, August 1 (Leng); Southern Pines, April 4 (Wenzel, Manee); North Carolina. Spring Hill, April 14 (Loding); Alabama. Indiana. (Frost and Leng collections). Beaufort, April 29 (Mason); South Carolina.

A rather uniform species easily identified by its dark color and whitish pubescence. It appears to be confined to the Southern States, the most northern locality known to the authors being Indiana. Certain individuals from here appear to approach *ovatus,* possessing faint dashes of ferrugineous pubescence among the white. This is also the first of several species which have the distinct sexual character of the females being remarkable for the deep emargination of the last ventral segment. After examining a rather lengthy series we find that in the material before us, the males are much the rarer, averaging only one to every thirty females. A recently published record[1] from S. W. Pennsylvania (Dr. Hamilton) we feel is a misidentification and refers to *ovatus* especially as the author Mr. Joseph Knull is inclined to share our view. Mr. C. A. Frost who has examined the type of *lugubris* in the Le Conte collection pronounces it identical with *tessellatus* which species was erroneously placed as a synonym of *ovatus* by Le Conte.

**Brachys floricola** Kerremans, 00–347 (Plate XI, fig. 4).
*cuprascens* Blatchley, 13–23.

(Translation of original description.)

"Subheptagonal, wide, short, slightly convex, clear bronze above with the head and depressed parts of pronotum ornamented by a villosity of golden red; the elytra colored by sinuate bands, formed by the golden red hairs and limited anteriorly by a white border on the end, the anterior band less distinct and less regular than the two others, the second being median and the third prëapical. Ventral surface black, brilliant and slightly purple. Length 5.3 mm; Width 2.7 mm. Florida.

"Close to *B. purpuratus* Kerrem., of Brazil, but differently colored and of a different elytral design.

"Head irregularly punctate, surmounted posteriorly by two rounded tubercles, glabrous and smooth, separated by a longitudinal furrow. Pronotum convex on the disk and flattened on the sides, posteriorly having a lateral carina situated a certain distance from the border and subparallel to the border, ornamented by a red villosity more dense on the sides than on the disk; the anterior margin being straight; the sides oblique and subsinuate; the base very sinuate with the median

[1] Knull, Can. Ent., 1922, Vol. LIV, No. 4, p. 86.

lobe wide, projecting and angularly curved at its summit. Shield transverse, triangular with the base convex and the sides straight. Elytra covered with a longitudinal series of large points having on both sides, a rib or carina starting at the base and surmounting the humeral callus continuing along the lateral margin a certain distance from it as far as the summit; the latter subtruncate and rounded exteriorly. Ventral surface punctate, prosternum finely granulate."

Broadly ovate. Elytral punctures coarse, large and in moderately regular rows, vestiture dense, elytra with usual lateral carinæ, tips pectinate, truncate to somewhat rounded. Ventral surface blackish with a bronze or purplish lustre, ventral segments very finely granulate with short recumbent, silvery or yellowish, rather sparse hairs; last ventral segment of the female deeply emarginate with long, golden hairs along the emargination; male segment broadly rounded without hairs. Length 4–5.5 mm.

*Localities.*—Billy's Island, Okefenokee Swamp, June (Leng); Georgia. Havlover, March (Hubbard and Schwarz); Jacksonville, Tampa, April 19 (Leng coll.); Enterprise, St. Augustine, April 17, (Frost coll.); Sanford, Ormond, March 29–April 6, Dunedin, March 11–April 7 (Blatchley); Miami, March 31–April 3, La Belle, April 18 (Knull, DeLong); Kissimmee, April 20 (Beutenmuller); Orlando, March, Key West (Nicolay coll.); Florida.

Easily separated from the preceding by the dense reddish pubescence. Although in his description Kerremans mentions the head possessing two rounded, glabrous tubercles, they are scarcely at all convex and in no way approach the distinct knobs so prominent in the *floccosus-cephalicus* group, also the longitudinal impression of the head is much less pronounced and shallower than in most of our species. In the rather extensive series before us the females far outnumber the males and are usually longer and more ovate. With the exception of a single individual from Georgia all the specimens are from Florida where the species is found in numbers.

**Brachys floricola** var. **blatchleyi** new variety.

Broadly ovate, slightly sinuate from shoulder to about apical half, thence rather gradually narrowed toward apices of elytra. Black, usually with a bluish-purple or more rarely bronzed lustre. Elytral punctures coarse, large, arranged in rather even striæ; lateral carina prominent, median ones less distinct, generally completely concealed by dense pubescence which is entirely of a light golden to silvery color, tips pectinate rather truncate to rounded.

Scutellum large, transverse, impunctate, and glabrous. Thorax and head as in *floricola,* pubescence of uniform silvery golden hue, very dense and almost completely covering tubercles above eyes on head. Ventral surface similar to that of *floricola* except possibly with a denser vestiture, last ventral segment of female deeply emarginate, long hairs along emargination, silvery; male segment broadly rounded. Length, 5–5.5 mm.

*Localities.*—Dunedin, March 11 (Blatchley); Lake Lucy, March 22 (Powell); Orlando (Pearsall); FLORIDA.

Holotype (♂) in the Nicolay collection. Allotype (♀) in the Frost collection. One paratype in each of the Leng and Schaeffer collections.

This variety is represented before us by four specimens (one male and three females). It is easily separated from *floricola,* which always has reddish brown pubescence bordered anteriorly by a white margin, by its uniform silvery golden vestiture. As in *floricola* the longitudinal impression of the head is remarkably shallow. *Blatchleyi* is evidently much rarer than the type. We take great pleasure in naming this variety after W. S. Blatchley who has done so much in making known the interesting coleopterous fauna of Florida. Undoubtedly Blatchley's reference to *lugubris*[1] Le Conte applies to this variety.

**Brachys ovatus** Weber, 01–76 (Plate XI, fig. 5).
*aurulentus* (Kirby), 37–162.
*tessellatus* ‡ Cast. & Gory, 39–3.
*terminans* ‡ Cast. & Gory, 39–3.
*molestus* Gory, 41–332.
*lævicauda* Le Conte, 59–252.
*horni* Kerremans, 96–324.

(Translation of original description.)

"Blackish bronze head and thorax golden pubescent, elytra punctate bronze with elevated lines and golden-ferruginous undulating bands. From America. Herschel.

"Size in general three times greater than *B. pygmæa.* Wholly very shining blackish bronze. Head and thorax covered with golden ferruginous pubescence. Margin of thorax reflexed. Elytra punctate with three elevated lines three undulating bands and suture shining. Posterior concolorous. Two small varieties also kindly communicated to me. Herschel. Strongly ovate, small, etc., may constitute a new genus."

[1] Canad. Ent., 1919, Vol. 51, No. 2, p. 30.

Ovate, distinctly sinuate from shoulder to about apical half, thence narrowed toward apices of elytra. Black usually with a virescent or brassy lustre. Elytra unevenly, rather shallowly punctate striate, lateral carina distinct, reaching almost to apex, medial and sutural ones less distinct but usually more so than in *floricola;* pubescence ferrugineous (rarely ferrugino-testaceous), arranged in three irregular sinuate, transverse fasciæ which are bordered by more or less distinct bands of whitish pubescence; concave behind shoulders which are prominent, tips pectinate, rather truncate. Scutellum large, transverse smooth. Thorax deeply, transversely depressed and widest at base, front convex, surface smooth to very minutely granulated, covered with a ferrugineous pubescence more sparse toward centre. Head with longitudinal impression distinct and usually much deeper than in *floricola,* rather concave pubescent tubercles above eyes not prominent. Ventral surface metallic, segments punctulate with very short, sparse whitish pubescence; last ventral segment of the female deeply emarginate with long dirty, golden hairs along the emargination; male segment broadly rounded to slightly truncate, without hairs; last dorsal segment pectinate in both sexes. Length 4–6.25 mm.

*Localities.*—This common species has a very wide distribution occurring in the East from Canada to Florida and west to Texas and Mexico where one specimen was taken at Zacualtipan in Hidalgo (Hoge).

Easily separated from the preceding by the usually more elongate and narrower form, less distinct elytral punctuation, sparser pubescence with a much broader glabrous space between medial and subapical bands and long hairs along the emargination of the last ventral segment of the female sparser. *Ovatus* has been redescribed more often than any of our North American *Brachys.* The *lævicauda* of Le Conte is merely the small form which naturally possesses a less distinct pectination of the tips of the abdomen. We believe that the size of the adult depends more or less upon the amount of food consumed by the larva. Sizes of leaves infested, weather conditions during the feeding season, etc., would affect the larval food supply. Mr. H. W. Wenzel takes a very dark and sparsely pubescent form at Da Costa, New Jersey. A partial loss of vestiture may take place naturally.

**Brachys ovatus** var. **bellporti** new variety.

Size, punctuation, and shape similar to those of *ovatus* differing only in the pubescence being uniformly of a light golden to silvery color. Black, generally with a bright æneous lustre, rarely purplish to bluish. Length, 4.25-6.25 mm.

*Localities.*—VERMONT (Leng. coll.). Framingham, Natick, May 23–July 27 (Frost); MASSACHUSETTS. Bellport, June 5–25 (Nicolay); Pinelawn, June 14 (Leng), Wading River, June 23 (Nicolay), Long Island; NEW YORK. Mount Pocono, July 8 (Nicolay), Hunters Run, July 11 (Knull); PENNSYLVANIA.

Holotype and allotype in Nicolay collection. Paratypes in Leng, Frost, Knull, Knaus, Amer. Mus. Nat. Hist., and Nicolay collections.

Occurs with *ovatus* but much rarer. *Bellporti* as a variety has the same relationship to *ovatus* as *blatchleyi* has to *floricola*. Named after the town where the type specimens were taken and where the senior author spent three pleasant summers of his early beetle collecting days.

**Brachys fasciferus** Schwarz, 78–363 (Plate XI, fig. 3).

(Original description.)

"Similar to B. *ovata* but shorter, broader in front and more attenuate behind and easily distinguished by the broad white fascia on the elytra and by the formation of the prosternum. Head and thorax as in *B. ovata* the former less strongly excavated. Elytra striate-punctate, punctures finer and obsolete towards the apex, anteriorly with irregular lines and patches of fulvous and whitish pubescence, behind the middle with a broad fascia of dense whitish pubescence with only a few fulvous hairs intermixed, behind this with two other undulated fasciæ composed of fulvous hairs, bordered anteriorly with white, humeral and marginal carina as in *B. ovata.* Fissure of prosternum not reaching the hind margin but leaving a comparatively broad margin intact; apex of metasternum in the middle suddenly and deeply emarginate. Last ventral segment with the usual marginal sulcus not emarginate in the male, broadly rounded in the female, less broadly in the male, anus very finely pectinate. Length 4–5.5 mm. Florida, not rare, lives on *Quercus virens.* In *B. ovata* and *tesselata* the undivided portion of the prosternum is very narrow and the metasternum is broadly triangular, emarginate in front."

*Localities.*—La Belle April 19 (Knull), Enterprise May 26, Cedar Keys, Jacksonville, Tampa April 4 (Hubbard and Schwarz), Dunel-

lon September 19, Anona September 17, Fort Myers September 13 (Rehn and Hebard), Kissimmee April 20 (Mason), Jupiter May 2 (Nicolay coll.); Florida. (Leng Collection.) Georgia.

This southern species is remarkably constant in size, color and arrangement of the pubescence. It can be separated from all others by the broad band of whitish pubescence just behind the middle, its uniformly dark color and rather broadly rounded last ventral segment. Also the abdominal segments are more densely pubescent than in our other species, the vestiture consisting of moderately long, recumbent ferrugineous hairs mixed with silvery ones which are dense along margins. Not rare where it is found.

**Brachys ærosus** (Melsheimer), 46–148 (Plate XI, fig. 7).
*tessellatus* ‡ (Melsheimer), 46–148.

(Original description.)

"*Trachys tessellata.* Black, elytra tesselated with white. Fabr. Syst. Eleuth. ii, 218, 1. The female is smaller than the male with the elytra dusky-purple, tinged with steel-blue, apex cupreous, varied with pale ferruginous; beneath glossy black, with the apex of the abdomen rounded. It is the *Buprestis ærosa,* Melsh. Catal."

Broadly ovate, sinuate from shoulder to about apical half, thence narrowed toward apices of elytra. Steel-blue often with a slight brassy or purplish lustre. Elytra very irregularly, rather densely and deeply punctate striate, carinæ same as in preceding species, pubescence ranging from gray to fulvous or yellow, arranged in three more or less distinct very irregular, sinuate, transverse bands, basal and medial bands often almost entirely wanting or represented by mere spots of pubescence, subapical band more decided, uniform and constant; concave behind shoulders which are prominent, tips pectinate. Scutellum large, transverse, smooth, surface variable. Thorax very deeply transversely depressed, widest at base, front convex, impunctate, clothed with short rather dense pubescence. Head with deep longitudinal impression, rather concave, pubescent, tubercles above eyes not very convex or prominent. Ventral surface black, shining or brassy, with very short, sparse whitish pubescence; last ventral segment in both sexes truncate to slightly rounded at sides, segment of female sometimes minutely sinuate but never emarginated as in preceding species. Length 3–5.75 mm.

*Localities.*—The most abundant and probably most widely distributed species being reported from Canada to Florida and west as far as Alberta, Canada in the north to Texas and Arizona in the south. Very common around New York City on oak leaves in early summer.

It is remarkable that this very variable species has been described but once and then only in a brief and inadequate way. *Ærosus* can be separated from *ovatus* and all of the preceding forms not only by lacking the deep emargination of the last ventral segment of the female but by the dense subapical pubescence while the basal and medial bands are usually quite broken and indistinct and never bordered by the narrow white fascia so common in *ovatus*. Furthermore the pubescence of the apex is often yellow or fulvous while that on the remainder of the elytra is gray. The larvæ having habits identical with those of the larvæ of *ovatus*, the great difference in size of certain of the adults may be due to the supposition already advanced. We believe that Le Conte in his revision mistook some of the small specimens of *ærosus* for *æruginosus* when he drew up his description of the species. The form with rather dark elytra and fulvous pubescence appears to be most common in New England where Mr. C. A. Frost has taken quite a large series especially around Framingham, Mass., and Paris, Maine.

**Brachys ærosus** var. **rufescens** new variety.

Same structural characters as those of the type. Differs only in the pubescence being a brilliant cupreous to ferrugineous, rarely intermixed with fulvo-æneous. Elytra generally cupreous to brilliant æneous but sometimes bluish-purple or very rarely without any purplish tinge. Pubescence usually much denser and fasciæ more distinct than in *ærosus*, especially the basal and medial fasciæ. Other characters identical with those of type. Length, 3.75–4.5 mm.

*Localities.*—Beaver Dam, June 14 (Snyder); WISCONSIN. Iowa City, June 3 (Lindsey); IOWA. Husted, May 22, June 30, Plainfield, June 14 (Nicolay); NEW JERSEY. Framingham, May 26 (Frost); MASSACHUSETTS. Buffalo (Leng collection), Bellport, June 7 (Nicolay), Jamaica, Long Island; NEW YORK. Hummelstown, June 20 (Knull); PENNSYLVANIA.

Type in the Nicolay collection. Paratypes in the Leng, Frost, Knull, Amer. Mus. Nat. Hist., and Nicolay collections.

This variety appears to reach its most distinct development in Iowa where the very depressed, cupreous examples with ferrugineous pubescence seem far removed from the typical *ærosus*. However several intermediates and peculiar individuals prohibit the

erection of a valid species. In fact among the hundred or more specimens of *ærosus* and its variety before us, are many forms which might fit in either the stem species or the variety. *Rufescens* occurs with *ærosus* but not in such large numbers.

**Brachys æruginosus** Gory, 41–335 (Plate XI, fig. 8).

(Translation of original description.)

"Æneous, granulose; thorax dilated; elytra irregular; ventral surface and legs obscure æneous. Length 3 mm. Width 1.75 mm.

"Bronze, granulated. Head finely punctured, very deeply in the middle. Thorax wider than the head anteriorly, gibbous at this part widening posteriorly which forms the very dilated posterior angles; its base is very sinuate and a little raised forming a depression between the gibbosity which is nearer the head and the base of the thorax. Shield triangular. Elytra wider at the base than the posterior angles of the thorax, slightly depressed behind the humeral angles, contracted and rounded at their extremities; these are granulated and irregular. Ventral surface of body and feet of an obscure bronze. This species is placed after *tenella*."

Rather broadly ovate, slightly sinuate from shoulder to about apical half thence gradually to sharply tapering to apices of elytra. Black usually with more or less of a brassy lustre. Elytra punctate striate, punctures coarse, shallow and irregular, intermixed with smaller ones; a very distinct carina running from humerus almost to apex of elytra; pubescence arranged in three irregular sinuate, transverse fasciæ, silvery to light golden in color, never rufescent, one subbasal, another median and the third near and usually covering apex of elytra, glabrous space between last two fasciæ broadest and most distinct; tips of elytra pectinate, truncate to slightly rounded; humerus distinct, elevated; body somewhat concave behind base. Scutellum narrow, very transverse, generally smooth but subject to the usual degree of variation common in this genus. Thorax deeply, transversely depressed at base, impunctate, widest at base rather sharply narrowed toward eyes; more brassy or bronzed than elytra, pubescence dense along basal and lateral margins, sparsely toward centre. Head with a deep longitudinal impression, concave, shining and with pubescence. Eyes prominent. Ventral surface brassy, abdominal segments with short, fine silvery pubescence, last segment narrowly

truncate to slightly rounded at sides, never emarginate. Length 3–3.75 mm.

*Localities.*—KANSAS. Sioux City, June 24 (Lindsey); IOWA. Framingham, May 31–June 6 (Frost); MASSACHUSETTS. Milltown, May 27; NEW JERSEY. Monmouth, June 22 (Frost); MAINE. Bellport, Long Island, June 5–July 22 (Nicolay); Staten Island (Leng), Pinelawn, Long Island, June 14; NEW YORK. Starke, Pulaski and Marshall Counties, June 11–19, rare (Blatchley); INDIANA. TENNESSEE (Nicolay collection).

This species has the structural characters of *ærosus* while the color and arrangement of the pubescence is similar to that of *ovatus* var. *bellporti*. It differs from the former by its uniformly smaller size and silvery pubescence and from the latter by the female not having the last ventral segment emarginate and always smaller and broader body. There is a rare form that has some ferrugineous pubescence mixed with the gray which however predominates. *Æruginosus* is not as common as either of the above species but is found along with them on the leaves of scrub oak in early summer.

LIST OF SPECIES.

GROUP TRACHES.

**Pachyschelus** Solier, 33–313.
*Metonius* Say, 36–264.
**purpureus** (Say), 36–164.
*americanus* Gory, 41–346.
**lævigatus** (Say), 36–164.
*ovatus* || (Say), 25–252.
*punctatus* (Gory), 41–347.
*carbonatus* (Le Conte), 59–252.
*politus* Kerremans, 96–322.
**schwarzi** Kerremans, 92–298.
*cæruleus* || Schwarz, 78–364.
v. **oculatus** Schaeffer, 09–377.

**Brachys** Solier, 33–312.
**floccosus** Mannerheim, 37–118.
**cephalicus** Schaeffer, 09–377.
**tessellatus** (Fabricius), 01–218.
*lugubris* Le Conte, 59–251.
**floricola** Kerremans, 00–347.
*cuprascens* Blatchley, 13–23.

v. **blatchleyi** nov. var.
**ovatus** Weber, 01–76.
*aurulentus* (Kirby), 37–162.
*terminans* ‡ Cast. & Gory, 39–3.
*tessellatus* ‡ Cast. & Gory, 39–3.
*molestus* Gory, 41–332.
*lævicauda* Le Conte, 59–252.
*horni* Kerremans, 96–324.
v. **bellporti** nov. var.
**fasciferus** Schwarz, 78–363.
**ærosus** (Melsheimer), 46–148.
*tessellatus* ‡ (Melsheimer), 46–148.
v. **rufescens** nov. var.
**æruginosus** Gory, 41–335.

**Taphrocerus** Solier, 33–314.

**puncticollis** Schwarz, 78–363.
**schaefferi** Nicolay & Weiss, 20–144.
**agriloides** Crotch, 73–75.
**lævicollis** Le Conte, 78–403.
**gracilis** (Say), 25–252.
*alboguttatus* (Mannerheim), 37–120.
*cylindricollis* Kerremans, 96–312.
? *texanus* Kerremans, 96–312.
**albonotatus** Blatchley, 19–29.

(*Brachys prætexta* Gory is a manuscript name. The description was never published.)

---

Bibliography.

Blatchley, 1919, Can. Ent., Vol. 51, No. 2.
Blatchley, 1910, Coleoptera of Indiana.
Blatchley, 1913, Can. Ent., Vol. 45, p. 23.
Burke, 1917, Bul. 437, Bur. Ent. U. S. Dept. Agric.
Chagnon, 1917, Ins. Quebec (Coleop.).
Crotch, 1873, Proc. Acad. Nat. Sci. Phila.
Deyrolle, 1864, Ann. Soc. Ent. Belg., Vol. 8.
Fabricius, 1801, Syst. Eleuth.
Gory (Castelnau & Gory), 1835–1841, Mon. Bup., & Suppl.
Kerremans, 1892, Mem. Soc. Ent. Belg., Vol. 1.
Kerremans, 1893, Ann. Soc. Ent. Belg., Vol. 37.
Kerremans, 1896, Ann. Soc. Ent. Belg., Vol. 40.
Kerremans, 1900, Ann. Soc. Ent. Belg., Vol. 44.
Kirby, 1837, Insects in Richardson's Fauna Bor. Amer., part 4.

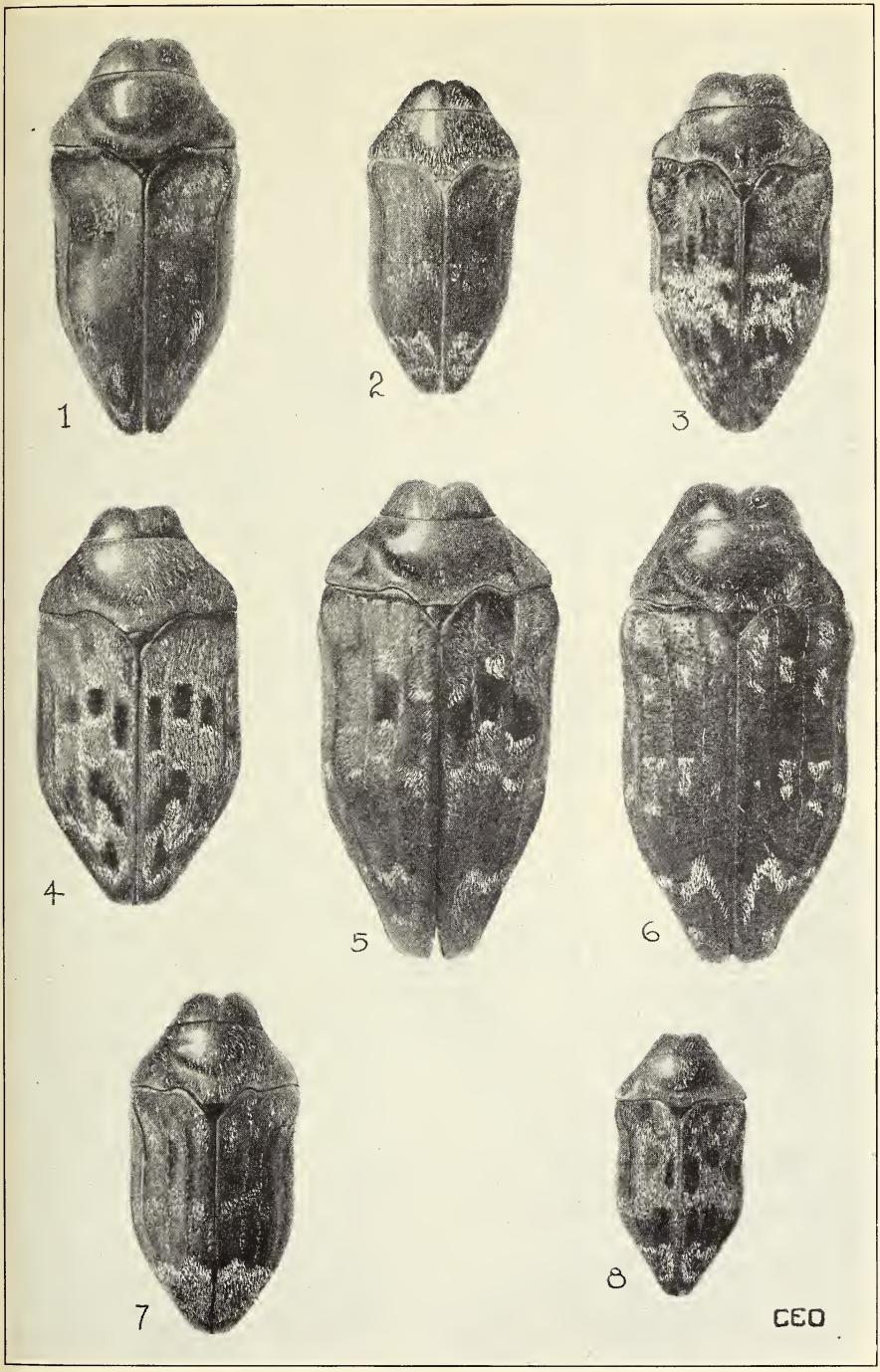
LACORDAIRE, 1857, Gen. Col., Vol. 4.
LE CONTE, 1859, Tr. Am. Phil. Soc. (Rev. Bupres.).
LE CONTE, 1878, Proc. Amer. Phil. Soc., Vol. 17 (Col. Florida, Mich.).
LE CONTE & HORN, 1883, Smith. Misc. Coll., 507 (Class Col.).
LENG, 1920, Cat. Coleop. Amer. n. Mex.
MANNERHEIM, 1837, Bul. Soc. Nat. Mosc., Vol. VIII.
MARSEUL, 1865, L'Abeille, Vol. 2.
MELSHEIMER, 1846, Proc. Acad. Nat. Sci. Phila., Vol. 2.
NICOLAY, 1921, JOUR. N. Y. ENT. SOC., Vol. 29, Nos. 3, 4 (additions to Leng list, Bup.).
NICOLAY & WEISS, 1920, JOUR. N. Y. ENT. SOC., Vol. 28, No. 2 (Genera *Pachyschelus* and *Taphrocerus*).
PACKARD, 1890, Fifth Rept. U. S. Ent. Comm.
SAY, 1825, Ann. Lyc. Nat. His. N. Y., Vol. I.
SAY, 1836, Tr. Am. Phil. Soc., Vol. VI.
SCHAEFFER, 1909, Mus. Brookl. Inst. Bul., Vol. I, No. 15.
SCHWARZ, 1878, Proc. Am. Phil. Soc., Vol. 17.
SMITH, 1909, N. J. State Mus. Rept. (Ins. N. J.).
SOLIER, 1833, Ann. Soc. Ent. France, 2.
WATERHOUSE, 1882–97, Biol. Cent. Amer., Col. Ser., Vol. 3, part 1.
WEBER, 1801, Observationes Entom.
WEISS & NICOLAY, 1919, Can. Ent., Vol. 51, pp. 86–88 (Notes on *B. ovatus* and *œrosus*).
WEISS & WEST, 1922, Ent. News, Vol. 33, pp. 180–183.

## ACKNOWLEDGMENTS.

We take this opportunity to thank Mr. W. S. Fisher who not only secured several obscure references for us but also dissected many specimens in order to ascertain for a certainty, the peculiar sexual differences of some of the species. We are also very grateful to Mr. C. W. Leng, Mr. C. A. Frost, Mr. Frank R. Mason, Mr. Warren Knaus, Mr. Charles Schaeffer and Mr. Andrew J. Mutchler for placing their collections at our disposal and to Dr. Henry Skinner for granting us access to the Horn collection.

## EXPLANATION OF PLATE XI.

FIG. 1. *Brachys floccosus.*
FIG. 2. *Brachys cephalicus.*
FIG. 3. *Brachys fasciferus.*
FIG. 4. *Brachys floricola.*
FIG. 5. *Brachys ovatus.*
FIG. 6. *Brachys tessellatus.*
FIG. 7. *Brachys œrosus.*
FIG. 8. *Brachys œruginosus.*




BRACHYS

# A PHYLOGENETIC COMPARISON OF THE MAXILLÆ THROUGHOUT THE ORDERS OF INSECTS.

BY G. C. CRAMPTON, PH.D.,

MASSACHUSETTS AGRICULTURAL COLLEGE,

AMHERST, MASS.

Since no comparative study of any structure, or set of structures, has been made in all of the insectan orders (considerations of the apterygotan orders, and of the apterous pterygotan orders, were naturally not included in the admirable studies of Comstock, Handlirsch, Tillyard, and others, who have sought to apply a uniform terminology to the wing veins of insects), I would present in the following discussion, the principal modifications of the maxillæ met with in the various insectan orders, including the Apterygota, as well as the wingless and winged Pterygota. Furthermore, since such a comparative study should always be made from the standpoint of phylogeny, I would also point out wherein the evidence of relationships gained from a study of the maxillæ is in complete accord with the conclusions regarding the interrelationships of insects reached through a study of the wings (Can. Ent., 1922, LIV, p. 206), and other features of the body, used as a basis of comparison, thus furnishing further support of the correctness of these conclusions by means of confirmatory evidence from other sources.

The leg-like mouthpart-limbs of the Trilobita (which are just like the trunk limbs, in these forms) are of far too primitive a type to be the immediate precursors of the modified mouthpart-limbs which form the mandibles, maxillæ, and other trophi in insects; and, as I have pointed out in several papers (JOUR. N. Y. ENT. SOC., 1921, XXIX, p. 63; Psyche, 1921, XXVIII, p. 84; Proc. Ent. Soc. of Washington, 1922, XXIV, p. 65, p. 153, etc.), there must have been a long series of intermediate stages, before the insectan types were evolved—and the Crustacea are the only known forms, which furnish these necessary intermediate stages connecting the insectan types with the trilobitan, and other structurally primitive types.

The view which I have encountered everywhere, among American entomologists at least, is that the immediate precursors of the Insecta are the Chilopoda; but I must confess that despite my absolute will-

ingness to do so, I have been utterly unable to derive any of the structures of insects from chilopodan prototypes—and this naturally applies to the maxillæ as well as to the other structures of the body. Even the most cursory glance at the chilopodan maxilla shown in Fig. 16, for example, should convince anyone of the utter impossibility of deriving a typical insectan maxilla (such as the one shown in Fig. 4 or Fig. 5) from such a source—yet the chilopod maxilla shown in Fig. 16 is quite typical of chilopods in general, in all essential features! If we are to derive the insectan type of maxilla from some prototype or other, it is surely quite reasonable to demand that the prototype in question shall at least bear some faint resemblance to its supposed derivative, but I do not know of any chilopod whose maxillæ (or any other structures, for that matter) would fulfil these conditions—and even the symphylan and other "myriopodan" maxillæ figured by Latzel, 1880, Hansen, 1903, and others, would not serve as suitable prototypes for the typical insectan maxillæ. Among the Crustacea, on the other hand, we find some types of maxillæ and maxillipeds which are structurally just like the maxillæ of insects, while others of the Crustacea approach the types occurring in the lower arthropodan forms, and the Crustacea thus furnish not only the necessary prototypes of the structures of insects, but they also furnish the necessary (and only available) intermediate stages connecting insects with the lower Arthropoda—and a study of these Crustacea enables us to correctly interpret the homologies of the various structures occurring in insects.

If, then, instead of wasting our time in the fruitless contemplation of a chilopod's maxilla (Fig. 16) we compare a typical insectan maxilla such as the one shown in Fig. 4 with the crustacean maxilliped shown in Fig. 3 (which is essentially similar to the maxilla of the same crustacean, shown in Fig. 2) it is at once quite obvious that the cardo *cp* of the insect shown in Fig. 4 corresponds to the coxopodite *cp* of the crustacean shown in Fig. 3, while the stipes *bp*, with its lacinia *be*, of the insect shown in Fig. 4 corresponds to the basipodite *bp* with its endite *be* of the crustacean shown in Fig. 3. Similarly, the palpifer *ip* with its galea *ie* of the insect shown in Fig. 4, corresponds to the ischiopodite *ip* with its endite *ie*, of the crustacean shown in Fig. 3; and the four segments *me*, *crp*, *pp*, and *dp* of the maxillary palpus of the insect shown in Fig. 4,

correspond in every way to the four segments *me, crp, pp,* and *dp,* of the maxilliped palpus (or endopodite) of the crustacean shown in Fig. 3—and the remarkably close correspondence in these two classes of arthropods extends not only to the number of segments involved, but also to the relative proportions of the individual segments of the structures compared.

The terminal portion *dl* of the lacinia *la* of an insect such as the one shown in Fig. 26 (or in Figs. 21, 22, etc.) may be referred to as the distilacinia (the basal portion *bl* of the lacinia being the basilacinia) and this distilacinia in a number of primitive insects bears a fringe, or fimbrium, made up of several modified spine-like structures corresponding in a remarkable fashion to the modified seta or spine-like structures occurring at the tip of the second endite of various crustacean maxillæ (*e.g.,* at the tip of the endite *ie* of Fig. 2). The remarkable correspondence in the minute details of the structures of the two groups of arthropods is at once apparent when we compare the fringe of the distilacinia of the insect shown in Fig. 24, with the fringe of the second endite of the crustacean shown in Fig. 25, in both of which there occur tooth-like "laciniadentes" labeled *a,* a longer "midappendix" labeled *b,* and pectinate "lacinulæ" labeled *le.* The "midappendix" labeled *b* in the crustacean shown in Fig. 17 is longer and more like that of the insect shown in Fig. 24 than is the case with the crustacean shown in Fig. 23; but the other parts of the fringe of the endite of the crustacean shown in Fig. 25 are more like the insect shown in Fig. 24 than is the case with the crustacean shown in Fig. 17.

The fringe or terminal structures labeled *a, b* and *le,* in the distilacinia of the Machilid insect shown in Fig. 15 are just like those bearing the same labels in the Podurid insect shown in Fig. 24 and the same types of structures occur in the terminal fringes of the distilaciniæ of other apterygotan insects such as the Entomobryid shown in Fig. 14, the Sminthurid shown in Fig. 8, the Sminthurid shown in Fig. 6, the Podurid shown in Fig. 12, etc., and even the Lepismatid insect shown in Fig. 9, has the marginal structures *a, b* and *le.* quite similar to those of the Entomobryid shown in Fig. 14 and the other Apterygota mentioned above. These parts in the Lepismatids and Machilids are so similar to those of the other Apterygota (and they are so different from the lacinial fringes of the maxillæ

of the Pterygota) that they lend additional weight to the many features which clearly indicate that the Lepismatids and Machilids (*i.e.*, the "Thysanura") are true Apterygota, and cannot be regarded as degenerate Pterygota, as Handlirsch and others are inclined to believe.

In addition to many other features of the body, the structure of the maxillæ of the Protura clearly indicates that the Protura are true apterygotan insects and that they are not very closely related to the "Myriopoda," as is claimed by certain investigators. If one compares the maxilla of the proturan shown in Fig. 22 with the maxilla of the "myriopod" shown in Fig. 16 it is at once apparent that there is no great similarity between the two, while on the other hand, if one compares the maxilla of the proturan shown in Fig. 22 with the maxillæ of the other apterygotan insects shown in Figs. 23, 21, 18, etc., the similarity is very striking. Thus the cardo *ca* of Fig. 22 is just like the cardo *ca* in Figs. 23, 21, 18, etc. The stipes *st*, with its lacinia *la*, of Fig. 22, is not essentially different from these structures in Figs. 18, 21, 23, etc., and the palpifer *pf*, with its galea *ga* of Fig. 22 is very similar to the palpifer *pf* with its galea *ga* in Figs. 23 and 21, while the maxillary palpus *mp* of Fig. 22 is quite like its homologue *mp* in Fig. 23. The evidence of the maxillary structures would therefore be in complete harmony with that furnished by other structures indicating that the Protura are true apterygotan insects.

As was mentioned above, the maxillæ of the Protura, Poduridæ, Sminthuridæ and Entomobryidæ are quite similar, and the evidence of the maxillary structures would be in harmony with the grouping of these insects into a proturoid division (Panprotura) of the subclass Apterygota based upon the nature of the body in general in these insects.

The Japygidæ and Campodeidæ (sensu lato) are somewhat intermediate between the proturoid Apterygota mentioned above and the thysanuroid Apterygota; and the maxilla of *Japyx* (Fig. 23), for example, is more like the maxillæ of the proturoid insects (Figs. 22, 21, 18, etc.) than it is like the maxillæ of the thysanuroid insects (Figs. 26 and 10), in many respects—as is also true of the head and mouthparts in general of the Japygidæ and Campodeidæ. On the other hand, the presence in the Japygidæ and Campodeidæ of

cerci, styli, and other abdominal structures which are not developed in the proturoid insects makes me more inclined to group the Japygidæ and Campodeidæ with the thysanuroids than with the proturoids, although I would not insist upon this grouping and it would doubtless be more exact to place the Japygids and Campodeidæ in a group intermediate between the proturoids and thysanuroids. For the sake of convenience, however, I have grouped them in the thysanuroid division (Panthysanura), in the following discussion. The lacinial fringe, *le,* of *Japyx* (Fig. 23) is more like that of certain Lepismatid thysanuroids such as the Lepismatids related to *Nicoletia,* than it is to the lacinial fringe of the proturoids, and the galea and palpifer *ga* and *pf* of *Japyx* (Fig. 23) is more suggestive of the Lepismatids than it is of the proturoids, so that the maxillæ of the Japygidæ and Campodeidæ may be said to be intermediate between the proturoid and thysanuroid types in some respects. The maxillary palpus was omitted in the drawing from which Fig. 13 was made but a comparison of the maxilla of *Campodea* shown in Fig. 13 with the maxilla of *Japyx* shown in Fig. 23 very clearly indicates that *Campodea* and *Japyx* are members of the same order of insects as is also borne out by a study of the structural details of the body in general so that the orders Rhabdura and Dicellura (in which the Campodeidæ and Japygidæ are frequently placed) should be merged into one.

*Machilis* (Fig. 26) is an extremely primitive thysanuroid insect, and in its maxilla the palpifer *pf* retains its primitive condition as a distinct segment not yet united with the stipes *st,* which is very like the stipes of the proturoids (Fig. 18, 21, 22, etc.) in its general character. The lacinial fringe labeled *a, b,* and *le,* in the Machilid shown in Fig. 15 is also strikingly similar to these structures in the proturoid insect shown in Fig. 24 and the huge development of the maxillary palpus *mp* (which, however, is composed of seven segments—a most unusual number) probably denotes the retention of a very primitive condition. These features are in harmony with many other facts which indicate that the Machilidæ are much more primitive insects than is usually supposed to be the case, and they have preserved a number of characters present in the ancestral insects, very suggestive of their crustaceoid prototypes. The Machilidæ also approach the Lepismatidæ quite closely (Fig. 10), and the

Lepismatidæ are very like the forms giving rise to the pterygotan insects, in many respects.

The maxillæ of the Lepismatidæ (Fig. 10) are astonishingly like the maxillæ of certain lower Pterygota, and in fact are more pterygotan than apterygotan in character (although this is not true of the maxilla of *Machilis* shown in Fig. 26, which is also a thysanuroid apterygotan). Thus the cardo, *ca,* of Fig. 10 tends to become divided into two sclerites *bc* and *dc;* the palpifer *pf* tends to unite with the stipes *st,* which thus appears to bear both galea *ga* and lacinia *la;* the lacinia *la* is quite pterygotan in character, and the number and relative proportions of the segments of the maxillary palpus *mp* of the insect shown in Fig. 10, are strikingly pterygotan. The fringe of the lacinia of the Lepismatid insect shown in Fig. 7 is also very like that of the pterygotan insect shown in Fig. 47, especially in the nature of the appendage *b.* On the other hand, the structures *a, b* and *le* of the lacinial fringe of the Lepismatid insect shown in Fig. 9 are more apterygotan (compare with Fig. 14), and taking the structure of the body as a whole, the Lepismatids are much nearer to the Machilids than they are to the Pterygota—and the Machilids are "out and out" Apterygota. When we take all of their structures into consideration, the Lepismatids are also more apterygotan than pterygotan, but in their maxillæ and certain other features, they furnish excellent annectant forms connecting the Apterygota with the Pterygota.

In comparing the maxillæ of the Pterygota, I shall have occasion to refer to areas and subdivisions which are possibly not familiar to anyone who has not made a special study of the maxillæ of insects, and on this account it may be well to briefly describe the principal parts of a typical pterygotan maxilla. For this purpose the maxilla of the orthopteran *Gryllus* (Fig. 33) will serve as well as any to illustrate the main features of value in comparing the various pterygotan types.

The cardo of *Gryllus* (Fig. 33) is composed of a basal area or basicardo *bc,* and a distal area or disticardo *dc,* and in addition to these, there may occur a cardomarginal area *cm,* which, however, is of no great importance, from the standpoint of comparative anatomy, while the basicardo and disticardo occur in long series of insects extending even to the higher Pterygota. The first desig-

nations to be applied to the areas *bc* and *dc* were the terms "paracardo" and "eucardo" (Psyche, XXIII, 1916, p. 83); but it is preferable to apply the designations basicardo and disticardo to these areas in all insects. As shown by DuPorte, 1920, and others, the basicardo is connected with the tentorium by a tentorio-basicardine muscle, and the disticardo is connected with the tentorium by a tentorio-disticardine muscle, both of which serve as adductors ("closers") of the maxilla. The cardo usually articulates with the hypostomal region of the head capsule by means of a cardocondyle *cc;* and a condylar groove in this area of the cardo usually receives a ridge or projection of the margin of the hypostomal region of the head capsule. The cardoprocess *cpr* is a process of the basal portion of the cardo to which muscles are attached by means of the cardotendons *ct*—such, for example, as the gena-cardotendon and postgena-cardotendon muscles, which serve as abductors ("openers") of the maxillæ by pulling down upon the cardoprocess, while the cardocondyle *cc* serves as fulcrum. Internally, the division of the cardo into a basicardo and disticardo is frequently marked by a transcardo plica or transverse infolding of the integument of the cardo, forming an internal ridge-like structure to which the adductor muscles may be attached. This division of the cardo into a basicardo and disticardo (*bc* and *dc* of Fig. 33) may possibly correspond to the division of the basal segment *cp* of the crustacean maxilla shown in Fig. 2; but this point has not as yet been definitely determined. A cardomarginal plica demarks the cardomarginal region internally.

The stipes forms the main portion of the "body" of the maxilla, and the palpifer *pf* tends to unite with it more or less closely in the Pterygota. The stipes is divided into a true stipes, or eustipes, *eus,* and a parastipes, *pas* (first defined in Psyche, 1916, p. 83), and this division persists in many types of insects. An internal parastipital plica or infolding of the integument along the line demarking the parastipes *pas* forms an internal ridge to which the tentorio-parastipital muscles (extending from the parastipital region to the tentorium, and serving as flexors ("closers") of the maxillæ, may be attached. The parastipes *pas* of Fig. 33 may possibly correspond to the narrow chitinized region *pas* of Fig. 2; but this again is pure speculation. The eustipes *eus* of Fig. 33 may be divided into a

basal region *bs* or basistipes, a distal region *ds* or dististipes, and a median region or mediostipes, labeled *ms* in Fig. 35, by the formation of sutures in the region *eus* of Fig. 33 (in which the beginnings of the formation of these sutures can be detected, while they have become completely formed in Fig. 35). Fig. 36 presents an intermediate condition in which the parastipital region *pas* (which is distinct in Fig. 33) tends to unite with the median region *ms* to form the larger median region *ms* of Fig. 35. A stipito-lacinial muscle from the stipes to the tendon at the base of the lacinia serves to flex the lacinia, while a stipito-galeal muscle from the stipes to the galea serves to flex the galea, and stipito-palpal muscles from the stipes to the basal segment of the maxillary palpus aid in extending and flexing the palpus. It is possible that the tension of the above mentioned muscles may play some rôle in the division of the eustipes into areas, but this is not very probable.

The lacinia may bear apical laciniadentes *ld* or tooth-like processes for holding and comminuting the food, and the appendage labeled *b* in Fig. 33 may be a modified tooth-like appendage, or a modified "lacinula" such as occur on the laciniæ of such insects as the one shown in Fig. 24 (*i.e.*, the structures labeled *le* in Fig. 24—of which the structure labeled *b* in Fig. 24 may be a modification). At any rate, the structure labeled *b* in Fig. 33 appears to be homologous with the structure bearing the same label in Fig. 47. The lacinia-fimbrium or fringe of hair-like, bristle-like, or spine-like structures bordering the lacinia has not been figured in most cases, since it is not very important for the purpose of demonstrating the affinities of the insects compared.

The galea is divided into a basal segment or basigalea *bg* and a distal segment or distigalea *dg* (first so designated in Psyche, 1916, p. 83) in Fig. 33, and this division of the galea into two segments occurs in a wide series of insects. The distal segment of the galea frequently bears a galeal sensarea, or sense area which usually remains membraneous and is provided with sensory organs in many insects. The distal segment of the galea bears a galeafimbrium or fringe in many coleopterous, neuropterous, and mecopterous insects, and the fringe of the galea and that of the lacinia are frequently modified for feeding purposes.

The maxillary palpus is usually five-segmented, with the basal two

(basimeres) small and subequal; the third (intermere) is frequently long, and the distal two (distimeres) are usually somewhat shorter, and subequal in size. The terminal segment of the maxillary palpus frequently bears at its tip a palpal sensarea which is usually membranous and richly provided with sense organs. Endomeral flexor and extensor muscles (within the palpal segments) serve to flex and extend the maxillary palpus.

Some of the modifications of the maxillæ in the various pterygotan orders are as follows. The cardo of a typical Odonatan (Fig. 30) is divided into basicardo and disticardo (*bc* and *dc*); but the parastipital region is not clearly demarked from the remainder of the stipes in most cases. The lacinia frequently bears numerous tooth-like processes, and the galea shows traces of two segments in many cases. The maxillary palpus is wanting in all of the Odonata I have examined (unless the structure here interpreted as the galea is in reality the maxillary palpus—in which case there is no galea), and this is possibly characteristic of the order.

In the Ephemerida (Fig. 31) the cardo may show traces of a division into basicardo and disticardo, and the stipes may show indications of a division into eustipes and parastipes, although I am not certain that the area labeled *pas* in Fig. 31 is strictly homologous with the areas bearing this label in other figures. In all of the Ephemerida which I have been able to examine, the galea and lacinia appear to unite to form a single maxillary "mala"; but in the naiads of the primitive New Zealand ephemerid *Oniscigaster* (Fig. 31) collected by Dr. J. W. Campbell and turned over to me to study by Dr. C. P. Alexander, the mala of the maxilla is divided by a well-defined suture which I have interpreted as the line of demarcation between the uniting galea *ga* and lacinia *la*. The union of the galea and lacinia is possibly characteristic of the order Ephemerida.

Certain ephemerid naiads (*i.e.*, immature forms) exhibit tooth-like processes of the lacinia very suggestive of those occurring on the lacinia of certain Odonata (Fig. 30); but the maxillæ of the Ephemerida are not as similar to those of the Odonata as might be expected from the fact that the Ephemerida and Odonata may be grouped in a superorder (Panarchiptera) on other grounds. The maxillæ of the Odonata are decidedly aberrant, and the same is true, to some extent, of the maxillæ of the Ephemerida, so that the general aberrant

nature of the insects in question may account for the lack of similarity between the two groups in certain features.

As may be seen in Fig. 1 the insects next above the thysanuroids are the palæodictyopteroid insects comprising the archaic Pterygota (division "Archipteradelphia") which include the Palæodictyoptera with their immediate relatives, together with the Prodonata, Odonata, Protephemerida and Ephemerida. In most of these insects the fore and hind wings are alike (homonomous), and they are unable to lay the wings flat along the top of the abdomen when at rest. Since they are among the most primitive of the Pterygota in many respects, I was much disappointed to find that the maxillæ of the Ephemerida and Odonata are rather highly modified, so that the evidence of the maxillæ alone would not indicate the true primitive nature of the insects in question, and we are dependent upon other features to determine their position in the scale of development indicated in Fig. 1.

The orthopteroid insects which are accorded the position immediately above the palæodictyopteroids in Fig. 1 constitute the division Orthopteradelphia, or lower pterygotan insects (the palæodictyopteroids constitute the archaic pterygotan insects). These orthopteroid insects or lower Pterygota tend to exhibit a heteronomous condition of the wings (*i.e.,* fore wings differing from the hind ones) due to the tendency toward the development of an anal fan in the hind wings. The wings are capable of being laid flat along the back of the abdomen.

The orthopteroid insects may be divided into three superorders called the Panplecoptera (comprising the Plecoptera, Embiids, and their immediate relatives), the Panorthoptera (comprising the Orthoptera, in the restricted sense, the Protorthoptera, the Phasmids, and the Dermaptera, with their immediate relatives) and the Panisoptera (comprising the Protoblattids, Blattids, Mantids, and the Isoptera, with their immediate relatives). Of these, the Panorthoptera and Panisoptera may be regarded as a single superorder; but for the sake of convenience, I shall treat them as separate groups in the following discussion. All of these insects are derived from the common Protoblattid-Protorthopteran stem, and hence exhibit marked intergradations making it very difficult to determine where to draw the dividing line separating them into definite groups.

The maxillæ of the Panplecoptera (Plecoptera, Embiids, etc.) are not as similar as one would expect from the marked similarity in wing-venation, terminal structures of the male insects, character of the thoracic sclerites and other features in the Embiids and Plecoptera, for example; but the character of the galea *ga* in the primitive Plecopteran shown in Fig. 44 (which was given to me by Dr. Tillyard) is very similar to the one of the Embiid shown in Fig. 40 (drawn from specimens collected by Dr. Wheeler and Dr. Bailey), and the nature of the lacinia *la* is practically the same in both Figs. 44 and 40. The cardo *bc* and *dc* is rather slender and elongate in both; but other than in the features mentioned above the Embiids and Plecoptera are disappointingly unlike in the general character of their maxillæ.

In the slenderness of their laciniæ *la* and galeæ *ga,* the Plecoptera shown in Figs. 44 and 46 are rather suggestive of the Dermaptera (Fig. 35), and the Plecopteran shown in Fig. 46 has a small terminal micromere *mm* similar to the micromere *mm* at the tip of the palpus of the Dermapteran shown in Fig. 35. The slender basigalea *bg* and distigalea *dg* of the Plecopteran shown in Fig. 46 are suggestive of the slender basigalea *bg* and distigalea *dg* of the Coleopteran shown in Fig. 37, and the formation of a chitinized plate or basimaxilla *bm* in the basimaxillary membrane at the base of the maxilla of the Plecopteran shown in Fig. 44 is also suggestive of the basimaxilla *bm* of the Coleopteran shown in Fig. 5. A similar basimaxillary plate *bm* occurs in the Isopteran shown in Fig. 45. The maxillæ of the Plecoptera therefore exhibit similarities to those of the Embiids, Dermaptera, Coleoptera, and Isoptera, and they are also suggestive of the maxillæ of the true Orthoptera such as those shown in Figs. 41, 34, etc. These facts are quite in harmony with the evidence from other sources which indicates that all of the forms in question are descended from the common Protorthopteran-Protoblattid stock. From this same stock the Phasmids were derived, and this probably accounts for the resemblance between the maxillæ of the Embiids (Fig. 40) and the Phasmids although the primitive Phasmid shown in Fig. 39 (drawn from a specimen given me by Dr. Ferris) does not illustrate this marked resemblance between the Phasmids and Embiids as well as might be desired.

The maxillæ of the Panorthoptera (*i.e.,* true Orthoptera, Phasmids,

Dermaptera, etc.), present some features of considerable interest from the standpoint of the origin of the higher Pterygota such as the Coleoptera, etc., and the hints which they offer are of considerable value. As was mentioned in the preceding discussion, the Gryllid shown in Fig. 33 illustrates the beginning of the breaking up of the eustipes *eus* into a basistipes *bs,* a dististipes *ds,* and a mediostipes *ms* which is still distinct from the parastipes *pas* in Fig. 34, but unites with it to form the enlarged mediostipes *ms* of Fig. 35. In the Dermapteran shown in Fig. 35, and the Orthopteran shown in Fig. 34 we clearly have the prototypes of the coleopterous maxillæ such as those shown in Figs. 37 and 36, in so far as the formation of the peculiar sclerites *pf, bs, ms* and *ds* is concerned (a condition occurring in no other insects so far as I am aware), and the marked similarity in these peculiar features clearly indicates that the Coleoptera, Dermaptera and Orthoptera sprang from common ancestors which were very like the ancestral Protorthopteran-Protoblattid stock which gave rise to the Orthoptera and Dermaptera (as well as to the Plecoptera and Embiida) at a lower level than that at which the Coleoptera branched off. The striking similarity in the character of the cardo, stipital region, slender galea and lacinia, etc., of the insects shown in Figs. 34 and 35 is clearly in harmony with the evidence from other sources (such as the nature of the thoracic sclerites and appendages, cerci, etc.) pointing to the Orthoptera as the nearest relatives of the Dermaptera; and the two groups apparently sprang from a common source in the common Protorthopteran-Protoblattid stock. The character of the cardo and the long narrow palpifer *pf,* together with the presence of a micromere *mm* at the tip of the maxillary palpus are features which add to the evidence from other sources pointing to the fact that the Hemimeridæ (Fig. 28) are merely modified Dermaptera (Fig. 35).

The maxilla of the very primitive Orthopteran *Grylloblatta* shown in Fig. 41 (which was drawn from a specimen loaned by Dr. Walker) gives some evidence that at a very early stage of Orthopteran development there occured a slender lacinia *la* which was not overtopped by the slender galea *ga* (in which respect the maxillæ of the primitive Orthoptera were doubtless more like that of the Plecopteran shown in Fig. 44, than they were like the maxillæ of the Blattid shown in Fig. 47); and this primitive condition is also re-

tained by the Dermapteron shown in Fig. 35 and the Orthopteron shown in Fig. 34. On the other hand, the galea *ga* of the Phasmid shown in Fig. 57 (which is a close relative of the primitive true Orthoptera) is broad and overtops the broad lacinia *la* as in the Blattids (Fig. 47) and their allies. The character of the cardo, stipital region, lacinia and galea of the maxilla of *Grylloblatta* would lend weight to the view that it is closely related to the true Orthoptera (Figs. 34, 33, 42, etc.) rather than to the claim made by other investigators who would place *Grylloblatta* nearer the Blattids and Mantids (Figs. 47 and 48). The maxilla of the Tridactylid (shown in Fig. 42) with its peculiar sclerite *lf* immediately proximal to the lacinia *la* is strikingly similar to the maxilla of the Tettigid shown in Fig. 43, thus lending further support to the view that the Tridactylidæ are much more closely allied to the Tettigidæ than they are to the Gryllidæ (as some investigators claim). The maxillæ of the Gryllidæ (Fig. 33) are very like the maxillæ of the Tettigoniidæ (the old "Locustidæ") such as the one shown in Fig. 32, and the maxillæ of the Tettigoniidæ are somewhat more like those of the "Acrididæ" (or Locustidæ, as they are now called) than the Gryllid maxillæ are. The maxillæ of some primitive Phasmids (Fig. 39) are more like those of the true Orthoptera, while the maxillæ of other Phasmids (Fig. 57) are somewhat more like those of the Blattids and Mantids (Figs. 47 and 48), thus lending weight to the view that the Phasmids are in a measure annectant between the Blattid-like forms and the true Orthoptera (and the lower phasmids, such as the one shown in Fig. 39, also approach the Embiid type shown in Fig. 40, thus indicating the synthetic nature of the Phasmids).

In the maxillæ of the Panisoptera (Blattids, Mantids, Isoptera, etc.) the galea *ga* is usually large and "fleshy" and overtops the lacinia *la*. The maxillæ of the Blattids (Fig. 47) are so like those of the Mantids (Fig. 48) that this would indicate that these insects should be grouped in a single order. The persistence in the Blattid shown in Fig. 47 of the pectinate "midappendix" labeled *b*, which occurs in certain apterygotan insects such as the one shown in Fig. 7, is a very primitive character; but the homologue of the structure labeled *b* in Fig. 47 probably also occurs in certain other members of the lower Pterygota (*e.g.*, Fig. 46, Fig. 33, etc.). The Isopteron

shown in Fig. 45 is not as much like the Blattids and Mantids shown in Figs. 47 and 48 as one would expect. The presence in the Isopteron shown in Fig. 45 (drawn from a specimen given me by Dr. Bequaert), of the basimaxilla *bm* is a feature suggestive of the Plecopteron shown in Fig. 44, and a similar basimaxillary plate *bm* occurs in the coleopterous larva shown in Fig. 5. The maxillæ of the Isoptera would bear out the conclusion that the Isoptera are the representatives of the superorder Panisoptera which are approached the most closely by the members of the other superorders (such as *Grylloblatta* (Fig. 41), etc., among the Panorthoptera, *Oligotoma* (Fig. 40) among the Panplecoptera, etc.) and this is probably due to the fact that the Isoptera are as near as any Panisoptera are to the Protorthoptera, whose line of development is paralleled by that of the other superorders in question. The evidence of the maxillæ of the insects in question would be in harmony with that from other sources, which indicates that the Blattids, Mantids and Isoptera are the descendants of the common Protorthopteran-Protoblattid stock from which the other lower Pterygota were also derived (*i.e.*, they branched off at the point where the common Protorthopteran-Protoblattid stock began to diverge from the Palæodictyoptera).

The so-called higher Pterygota (Neuropteradelphia) are characterized by the fact that the wings are heteronomous, the fore wings being usually larger than the hind ones, and the wings are either laid flat along the abdomen when at rest or are held "roof-like" over it, in most cases. There are two principal superorders of higher Pterygota. These are the Panhemiptera (Hemiptera with the Homoptera, Psocids, Mallophaga, Pediculids, etc.) and the Panneuroptera which include the Neuroptera, Coleoptera and Hymenoptera, etc., together with a group of higher Neuropteroids composed of the Mecoptera, Diptera, Siphonaptera, Lepidoptera, Trichoptera, etc. These higher Neuropteroids have been grouped in a separate superorder, the Panmecoptera; but it might possibly be preferable to include them in the superorder Panneuroptera rather than place them in a distinct superorder.

Among the Panhemiptera (Psocids, Mallophaga, Anopleura, Hemiptera, etc.) the Psocids have retained the maxillæ in the most primitive condition occurring in the superorder, thus bearing out the

evidence from other sources that the Psocids have departed as little as any from the condition approximating the original one for the superorder. In a previous paper (Can. Ent., 1922, LIV, p. 206) the Zoraptera were placed in the order Psocida (Parahomoptera) on account of the great similarity of the wings, head capsule, legs, testes, and other structures of the Zoraptera to those of the Psocids. I must admit, however, that the maxilla of a Zorotypid (suborder Zoraptera) such as the one shown in Fig. 38 (which was made from a specimen given me by Mr. Caudell) is of a much more primitive type than the maxilla of any other Psocid I have been able to find (*e.g.*, the one shown in Fig. 73 is typical of the Psocids in general). In fact, the maxilla of the Zorotypid shown in Fig. 38 is as "orthopteroid" as any of the higher insects, and on this account, I have placed the Psocoid insects (*i.e.*, the Psocids, Mallophaga, etc.) immediately above the "orthopteroids" in Fig. 1. The maxilla of the Zorotypid shown in Fig. 38 is very similar to that of the Phasmid shown in Fig. 39 and resembles the maxilla of the Embiid shown in Fig. 40 extremely closely. This resemblance is in harmony with the evidence of the wing veins, for example, which indicate that the Zoraptera were derived from Protorthoptera-like forbears closely allied to those from which the Embiids were derived, and the Phasmids were probably descended directly from Protorthopterous forbears. The Zorotypids approach the Isoptera in many respects, and one would expect that the maxilla of the Zorotypid shown in Fig. 38 would be more like that of the Isopteron shown in Fig. 45 than is the case. There is some resemblance between the two maxillæ, however, and this is probably due to the mutual relationship of the Zoraptera and Isoptera to the Protorthoptera (or to the Protorthopteran-Protoblattid stem from which both were descended).

The maxillæ of the Psocids (Fig. 73) are strikingly similar to those of the Mallophaga (Fig. 74), thus strongly supporting the view that the Mallophaga were descended from Psocid-like ancestors. As has been suggested by others, the stylet-like structure labeled *la* in Fig. 73 may represent the lacinia and if the structure labeled *la* in Fig. 73 is the lacinia, the structure labeled *la* in Fig. 74 must be the lacinia also. It is likewise quite probable that the structure labeled *la* in Fig. 72 is homologus with the structure labeled *la* in Figs. 73 and 74, and the maxillæ of the Thysanoptera (Fig. 72) ap-

proach those of the Psocids (Fig. 73) quite closely in their general features, thus adding further weight to the view that the Psocids and the Thysanoptera were descended from common forbears closely allied to the Protorthoptera. The mouthparts of the Anoplura (Fig. 76) are too highly specialized to offer any very serviceable clews as to immediate relatives of the group. The maxillæ of the Anoplura, however, are as near to those of the Mallophaga as any, and the nature of the mouthparts would not preclude their derivation from ancestral types related to the Mallophaga and Psocids—an ancestry which is indicated by other features of the body in general.

Although the Hemiptera appear to have lost them completely, the maxillary palpi are retained in both Thysanoptera (Fig. 72) and Psocids (Figs. 73 and 38), and the galea *ga* and stipites *st* of these insects are much more primitive than the structures labeled *ga* and *st* in the Homopteron shown in Fig. 75 (drawn from a specimen given me by Mr. Gowdey); and the evidence of the maxillary structures would indicate that the Psocids have departed much less than the Homoptera have from the ancestral condition of the Psocoid insects in general, although the phenomena of heterarchaism or heterospecialization (*i.e.*, the unequal primitiveness or specialization of the different parts of an organism, which frequently preserves some structures in a relatively primitive condition while other structures in the same individual may be rather highly specialized) make it very difficult to determine which insects are the more primitive when such unequally specialized forms are compared. The structure labeled *la* in Fig. 75 appears to be homologous with the structure labeled *la* in Fig. 73, and possibly represents the lacinia in which the basal portion has become invaginated to form a chitinous cup below the surface of the integument of the head capsule. The curled drum-like basal portion of the structure labeled *la* in Fig. 75 apparently represents the basal portion of the newly forming lacinia which fits into the old lacinia *la* of the nymph, in the fashion described by Snodgrass, 1922, in the cicada. The evidence of the maxilla would be in harmony with that from other sources indicating that the Hemiptera (with the Homoptera) were derived from ancestors which were the same as, or were very like those of the Psocids; and the grouping of the Psocids, Mallophaga, Anoplura and Hemiptera (with the Homoptera) into the superorder Panhemiptera is apparently a natural one.

The Coleoptera, Strepsiptera, Hymenoptera and Neuroptera with their allies form the Neuropteroid superorder Panneuroptera; and it is largely a matter of personal preference whether we restrict the superorder Panneuroptera to these forms or also include in the superorder Panneuroptera the higher Neuropteroids such as the Trichoptera, Lepidoptera, Mecoptera, Diptera, Siphonaptera and their allies (which might be grouped in a superorder Panmecoptera distinct from the rest of the Neuropteroids or holometabolous insects).

In some respects the Coleoptera are among the most primitive of the Neuropteroid insects, and as was pointed out above, their maxillæ Figs. 36 and 37) are strikingly similar to those of the Dermaptera (Fig. 35) and Orthoptera (Fig. 34), and even such highly modified parasitic Coleoptera as the Platypsllids (Fig. 29) and Leptinids (Fig. 27) appear to be modified along paths of specialization presaged in the parasitic Dermaptera of the family Hemimeridæ (Fig. 28). In this connection it should be remarked that the maxillæ of the Platypsyllids and Leptinids (Figs. 29 and 27) are so similar that, in addition to other features (such as the character of the head and body in general), the evidence of the maxillæ, etc., leaves no room for any doubt that both groups are anything else than modified Coleoptera (the generally accepted view), as I found out when I was able to compare specimens of both families loaned me by Dr. Cooley and Dr. Boving. It is not beyond the range of possibility that these two Coleopterous families have not departed far from the types which give rise to the Mallophaga and other Psocid-like forms, since the order Coleoptera took its origin very near the point at which the line of development of the Psocid-like forms arose from ancestors resembling the Protorthoptera, although the ancestors of the Coleoptera were identical with or very similar to the forms which gave rise to the Neuroptera (and occupied a position at the point where the common stem of the Protorthoptera and Protoblattida began to diverge from that of the Palæodictyoptera). The line of development of the Coleoptera is a rather aberrant one; but their nearest relatives appear to be the Neuroptera and Hymenoptera, and the maxillæ of certain Coleopterous larvæ are strikingly like those of certain lower Neuropterous larvæ (as may be seen by comparing Fig. 5 with Fig. 4, although the larvæ there shown are not the best fitted for illustrating the striking resemblance between the Coleoptera and Neuroptera).

The galea *ga* of the Neuropteron shown in Fig. 50 is rather slender and is divided into a basigalea *bg* and a distigalea *dg* suggestive of the condition exhibited by such Coleoptera as the one shown in Fig. 37; and, although this is not true of all Neuroptera (*e.g.*, the one shown in Fig. 49) there is a tendency in the Neuropterous maxillæ for the cardo to become quite slender (Figs. 50 and 51) and for the maxilla as a whole to depart rather widely from the Orthopterous type. The elongation of the maxillæ in the Neuroptera is apparently accomplished by the lengthening of the stipes *st* of Fig. 51, and of the lacinia *la* and galea *ga* which become long slender organs in the Neuropteron shown in Fig. 51. The lacinia *la* of the Neuropteron shown in Fig. 51 is longer than the galea *ga*, which is a rather unusual condition among insects in general; but a comparison with the other Neuroptera shown in Figs. 50 and 49 very clearly indicates that the structure labeled *la* in Fig. 51 is the true lacinia, and the structure labeled *ga* is the entire galea, which is divided into a basal and distal region (*bg* and *dg*) as in the Neuropteron shown in Fig. 50. When the cardo is long and slender in the Neuroptera (as in Figs. 50 and 51), it is still so oriented that its basal end is directed inward or toward the median plane of the body (*i.e.*, the maxilla is endocardine); but in the Hymenoptera, when the cardo is long and slender (as in Figs. 54, 55, and 56), its basal end is usually directed outward, or toward the lateral region of the body (*i.e.*, the maxilla is exocardine). In this respect, the maxillæ of even such primitive Hymenoptera as the one shown in Fig. 54, are rather highly specialized. In the very primitive Hymenopteron shown in Fig. 58 (which was drawn from specimens given me by Mr. Rohwer and Mr. Middleton), however, the cardo is more "normal."

In the Hymenoptera shown in Figs. 58 and 59, the galea *ga* is partially split into an inner lobe *eng* or endogalea and an outer lobe *exg* or exogalea; and this division into two lobes *exg* and *eng* apparently occurs in the galea *ga* of the Phasmid shown in Fig. 57 also. The Hymenoptera (together with the Neuroptera and Coleoptera) were apparently derived from ancestors in or extremely closely allied to the common Protorthopteran-Protablattid stock which gave rise to the Phasmids (and Isoptera also), and it is quite possible that both Hymenoptera (Fig. 58) and Phasmids (Fig. 57) may have inherited from a common source, the tendency for the galea *ga* to split into

the external and internal lobes *exg* and *eng;* but this is pure speculation. At any rate, the Hymenoptera and the Phasmids are the only insects in which this tendency is exhibited, so far as I am aware, and I am unable to determine whether this tendency in the two orders is due merely to convergence or not. In many of the higher Hymenoptera, the lacinia *la* is greatly reduced (Figs. 55, 56, etc.), and the galea *ga* becomes folded upon itself, in some instances giving the appearance of the folds becoming adherent to each other so closely as to produce a more or less complete fusion of originally separate lobes. Whether these adhering lobes have any particular relation to the small lobes *exg* and *eng* of Fig. 58, is not clear. The maxillary palpi of certain of these higher Hymenoptera, such as the one shown in Fig. 54 or Fig. 55, appear to be composed of more than the usual five segments, and taken all in all, the maxillæ of the Hymenoptera exhibit the most remarkable specializations I have found among insects (with few exceptions).

For the sake of convenience, I shall refer to the higher Neuropteroids (*i.e.,* the Trichoptera, Lepidoptera, Mecoptera, Diptera, Siphonaptera, and their immediate relatives) as the "Panmecoptera," grouping them in a superorder distinct from the lower Neuropteroids or Panneuroptera (*i.e.,* the Neuroptera, Coleoptera, Strepsiptera, and Hymenoptera, with their immediate relatives), since the higher Neuropteroids are more closely related to each other than they are to the lower Neuropteroids, although they naturally intergrade with the lower forms, and the superorder Panneuroptera might be made to contain them also in a natural assemblage of holometabolous insects. It is very difficult to determine which of the higher Neuropteroids is the most primitive, since the Trichoptera have retained a very primitive type of venation in some instances (particularly in the anal region of the hind wings), and the maxilla of such Lepidoptera as the one shown in Fig. 77 is as primitive as any I have been able to find among the higher Neuropteroids; but taking their anatomy as a whole, the Mecoptera are doubtless the most primitive representatives of the higher Neuropteroids (Panmecoptera).

The maxilla of the primitive Mecopteron shown in Fig. 53 is quite "orthopteroid" in many respects, and it bears some resemblance to the maxilla of the Embiid shown in Fig. 40. In those Mecoptera in which the cardo is slender and elongate, as in Fig. 70 (drawn from

a specimen given me by Dr. Tillyard), the cardo is turned outward (*i.e.*, the exocardine position obtains); but in most Mecoptera, the cardo is not elongate, and is turned inward (*i.e.*, the maxillæ are endocardine) as in Figs. 52, 53 and 60. Lengthening of the maxilla is usually accomplished by the lengthening of the stipes *st* which may be accompanied by a lengthening of the galea *ga* and lacinia *la* as in Fig. 52, or the galea and lacinia may not take part in the process, as in Fig. 60.

The Mecoptera approach the Hymenoptera in so many features that one might be led to think that the structures labeled *ga* and *la* in Fig. 60, instead of representing the galea and lacinia (as the labels would indicate), should be interpreted as representing the divided lobes *eng* and *exg* of the galea *ga* of the Hymenoptera shown in Figs. 59 and 58. That this view is entirely untenable, I am convinced for the following reasons. The structures labeled *ga* and *la* in the Mecopteron shown in Fig. 60 are entirely homologous with the structures labeled *ga* and *la* in the Mecoptera shown in Figs. 53 and 52, and what applies to one applies to all. If one compares the structures labeled *ga* and *la* in the primitive Mecopterous maxilla shown in Fig. 53 with the structures labeled *ga* and *la* in the primitive Hymenopteron shown in Fig. 54, or with the Embiid shown in Fig. 40, it is at once evident that the structures bearing the labels *ga* and *la* in all three insects are entirely homologous, and represent the galea and lacinia in all of them, including the Mecopteron shown in Fig. 53. Similarly, if one compares the structures labeled *ga* and *la* in the Mecopteron shown in Fig. 52 with the parts bearing the same labels in the Neuropteron shown in Fig. 51, it is quite apparent that the structures are entirely homologous in both, hence the structures labeled *ga* and *la* in Fig. 52 must represent the galea and lacinia, since their exact homologues *ga* and *la* in Fig. 51 represent the galea and lacinia, as may be seen by running back in the series of Neuroptera shown in Figs. 51, 50 and 49.

The evidence of the maxillæ would indicate that certain Neuroptera (Fig. 51) approach certain Mecopterous types (Fig. 52) more closely than is true of any other insects, and the evidence of the venation of the wings would also strengthen this view. On the other hand, the nature of the male reproductive organs and certain other features would indicate that the Hymenoptera also approach the Mecoptera very closely in many respects, and the type of Hymenopterous maxilla shown in Fig. 69 is very like that of the Mecopteron shown in Fig.

70 thus lending further weight to the latter view. I even find some features in certain Coleoptera which strongly suggest a close relationship to the Mecoptera; and all of these resemblances are doubtless due to the fact that the Mecoptera are descended from the same ancestors which gave rise to the lower Neuropteroids such as the Coleoptera, Neuroptera and Hymenoptera. As far as the maxillæ are concerned, the Neuroptera (Fig. 51) and Hymenoptera (Fig. 69) approach the nearest to the Mecopterous types (Figs. 52 and 70); although the tendencies exhibited by certain Coleoptera even in the maxillæ (Fig. 68) are not very different from those exhibited by the Mecoptera and Hymenoptera shown in Figs. 70 and 69.

Practically all of the structures of the Mecoptera are strikingly similar to those of some Diptera, and the evidence of the maxillæ bears out the relationship indicated, in a remarkable manner. Thus in the Dipteron shown in Fig. 71 and the Mecopteron shown in Fig. 70, the cardines *ca* are of the exocardine type, the character of the stipes *st* and galea *ga* is strikingly similar in both, and even the relative proportions of the segments of the maxillary palpi *mp*, both of which bear a peculiar sense organ *so* on the third segment, are remarkably similar down to the minutest details. Even the tendency for the stipes of both maxillæ to unite with the mentum of the labium to form a synstipites, as in the Dipteron shown in Fig. 71, is paralleled in the Mecoptera; and the comparative morphology of the various structures in the two groups of insects must convince even the most skeptical that the Mecoptera are the nearest living representatives of the types ancestral to the Diptera. I do not feel sure that the Diptera were descended from the Mecoptera themselves, however, since I am more inclined to consider that the Diptera were descended from the Neuropteroid forbears of the common stock which gave rise to the Mecoptera and Trichoptera, and these ancestral types quickly merged with the ancestral Neuroptera and Hymenoptera, so that features present in the Neuroptera and Hymenoptera may also be carried over into the Dipterous line of development. The series represented by Figures 68, 69, 70 and 71 is a very suggestive one, and the relationships indicated by the maxillæ of the insects in question are confirmed by the evidence of many other structures, so that the similarity is hardly due to convergence, but is rather the result of common tendencies inherited from a common ancestry.

In the Dipteron shown in Fig. 80, I have not interpreted the structure labeled *il* as the representative of the lacinia, since the structure in question is imbedded in the basimaxillary membrane in a fashion unknown in any lacinia, and the structure labeled *il* in Fig. 80 is apparently homologous with the interlora *il* of Fig. 55, which is a chitinous bar extending between the maxilla and the region of the hypopharynx. In Fig. 55, however, the maxilla was turned so far over that the structure labeled *il* appears on the other side, although if seen from another angle, it would appear to be on the same side of the maxilla as the structure labeled *il* in Fig. 80; and in the Hymenopteron shown in Fig. 69 the structure *il* is shown much better for comparison with Fig. 80, than is the case with the Hymenopteron shown in Fig. 55. In the Dipteron shown in Fig. 66, the galea *ga* has become enormously elongated, and this tendency for the galea to become very long also occurs in many other Holometabola, such as the Coleopteron shown in Fig. 67, various Lepidoptera, etc. The elongation of the maxilla may be accomplished through the lengthening of the galea, or of the stipes, or of both galea and stipes.

Figure 65 shows the condition typical of the Siphonaptera (fleas) in general, and since all of the parts are preserved in a fairly typical condition, I fail to see how there can be any uncertainty as to the interpretation of the mouthparts of the fleas. The cardo *ca* is of the endocardine type, and hence differs from the Diptera I have seen—and in fact the whole character of the maxilla of the Siphonapteron shown in Fig. 65 is more primitive than most Dipterous maxillæ (and even exhibits a marked resemblance to a Psocid's maxilla) thus indicating that the line of development of the Siphonaptera probably branched off from the ancestral Diptera while the latter had still preserved many Trichopterous and Mecopterous features. The sclerite *pf* of the flea shown in Fig. 65 probably represents the palpifer, and if this is the case, the palpifer is larger and better demarked than in any Diptera, Trichoptera, or Mecoptera I have seen. The lacinia is atrophied (as in Diptera and most Trichoptera) while the galea *ga* is suggestive of that of certain Diptera and Trichoptera. It is rather surprising that the maxillæ of most fleas are not more elongate, since most of the blood-sucking insects allied to the Siphonaptera have long slender maxillæ.

In the Trichoptera, lengthening of the maxilla may be accomplished by the lengthening of the cardo *ca* as in Fig. 62, or more rarely, by the lengthening of the galea *ga* as in Fig. 63, and the latter insect exhibits a tendency toward the lengthening of the galea which takes place to such a remarkable degree in the Lepidoptera. The Trichoptera are usually ectocardine (Figs. 62 and 64, *ca*) as is the case with most Diptera, and Hymenoptera, and in this respect the Trichoptera differ from their near relatives the Lepidoptera, which are mostly endocardine. The cardo *ca* of the Trichopteron shown in Fig. 63 (drawn from specimens given me by Mr. Banks and Dr. Betten) however, is not turned markedly inward or outward, although it might be considered endocardine, if the structure bearing the label *ca* in Fig. 63 is really the cardo. The galea *ga* of the Trichopteron shown in Fig. 62 is suggestive of the Dipterous type; while that of the Trichopteron shown in Fig. 64 is faintly suggestive of certain Hymenoptera. The maxillæ of the Trichoptera which I have studied are not as similar to the maxillæ of the Mecoptera as one might expect, and they are disappointingly unlike the maxillæ of most Neuroptera. They do resemble the maxillæ of the Diptera (with the Siphonaptera) and Hymenoptera, however, and are suggestive of the Lepidoptera in many features. The evidence of the maxillæ of the Trichoptera would therefore indicate rather close affinities with the Lepidoptera, and would point to a common ancestry with the Hymenoptera, Diptera and Siphonaptera, which may be interpreted as meaning that the Trichoptera arose from the Neuroptera-like forbears from which the Hymenoptera were derived, and their line of descent branched off with that of the Mecoptera; while the Diptera, with their derivatives the Siphonaptera, were descended from ancestors which also arose at this point.

The maxilla of a Lepidopteron such as that shown in Fig. 77 is much more primitive than any Trichopteron I have seen, and this indicates that the Lepidoptera may have arisen from ancestors more primitive than either Trichoptera or Mecoptera; and their forbears may have been more like those of the Neuroptera—although the maxilla of the Mecopteron shown in Fig. 53 is almost as primitive as that of the Lepidopteron shown in Fig. 77. The division of the cardo *ca* into basicardo *bc* and disticardo *dc* in the Lepidopteron shown in Fig. 77

denotes a persistence of a primitive Orthopteroid feature which, however, also occurs in the Neuroptera (Figs. 50 and 51) as well, and is retained even in the more highly specialized Neuroptera. The division of the galea *ga* into a basigalea *bg* and a distigalea *dg* is another primitive survival in the insect shown in Fig. 77—and a similar division is also retained in the Neuroptera (Fig. 50) as well. The huge development of the maxillary palpus *mp* in Fig. 77 is a feature which also occurs in the primitive Hymenopteron *Xyela* (not shown in Fig. 58) as well as *Philopotamus* among the Trichoptera, and is a point of similarity between these three groups, although its significance is not very important from the standpoint of phylogeny.

In the Lepidopteron shown in Fig. 78, the maxillary palpus *mp* has grown shorter as the galea *ga* grows longer, and finally in such Lepidoptera as the one shown in Fig. 79, in which the galea *ga* is hugely developed, the maxillary palpus is reduced to the small vestige bearing the label *mp*. In connection with the discussion of the maxillary palpus of the Lepidopteron shown in Fig. 78 (drawn from specimens given me by Dr. Busck), I would call attention to the outgrowth *ppr* of the basal segment of the maxillary palpus, which is unlike anything I have seen in any other insect, although it is a little suggestive of the structure labeled *ga* in Fig. 4, which I have interpreted as the galea in Fig. 4,—but this structure is not on the same side of the sclerite at the base of the maxillary palpi as the structure labeled *ppr* in Fig. 78. The palpiprocess *ppr* of the yucca moth shown in Fig. 78 occurs only in the female of this moth and it is indeed astonishing that no other insect should exhibit structures approaching it. Although the use of the organ in question for holding the pollen mass when the female moth pollenizes the yucca flower may account for its persistence and further development when once developed (since the moth has become absolutely dependent upon the yucca plant for its racial existence) we would expect some indications of the formation of a similar structure (though not so well developed) in allied insects, and when the related species have been studied with this in view, we shall doubtless be able to account for the origin of this peculiar structure which is the most remarkable that I have encountered in any insectan maxilla.[1]

[1] Dr. Adam Boving tells me that certain Dascillid beetle larvæ have a structure comparable to this in their maxillæ.

The moth shown in Fig. 78 shows a slight indication of the formation of the paralora *pl* which is well developed in Fig. 79, and may possibly be a structure peculiar to the Lepidoptera, since I have not found it developed in exactly this fashion in the other orders examined. It appears to be developed in connection with the reduction of the labium, and very probably occurs in other insectan orders in which the labium is reduced. The folding of the galea *ga* of the insect shown in Fig. 79, may bear some relation to the peculiar folding of the galea of the Hymenoptera; but I have not yet had the opportunity of investigating this interesting subject further, although I am hoping to do so in the near future.

The maxilla of the aberrant Strepsipteran type shown in Fig. 61 (drawn from a specimen given me by Dr. Brues) is suggestive of the maxillæ of certain Trichoptera, in which the reduced maxillary palpi are about all that is left of the maxillæ. It is quite possible that certain Coleoptera will also exhibit the same phenomenon of the reduction of the maxilla to a palpus borne at the end of a ridge extending across the under side of the head in the region where the atrophied labium was formerly borne; but I have not been able to find such a Coleopteron, and the maxilla of the Strepsiptera would appear to be more like that of certain Trichoptera than any other insects, although I am inclined to regard the Strepsiptera as highly aberrant forms arising from the ancestral Coleoptera near the point of origin of the ancestors of the Hymenoptera and Trichoptera. The Strepsiptera exhibit certain features in common with the Coleoptera, Hymenoptera and Trichoptera, and the above-mentioned origin for the group is the one which best accords with the facts, although I have provisionally placed the Strepsiptera next to the Coleoptera (the usual grouping of these insects). In so placing the Strepsiptera, however, I would not minimize their annectant character between the Coleoptera on the one side, and the Hymenoptera and Trichoptera on the other.

The interrelationships of the orders of living insects indicated by the comparative morphology of various structures such as the wing-veins, mouthparts, terminal abdominal structures, etc., are briefly set forth in the following groupings, in which a few fossil forms are included because of their phylogenetic importance.

CLASS INSECTA.

SUBCLASS I. Apterygota.

Division A. Proturadelphia.

Superorder 1. Panprotura.

Orders: Protura, Collembola, etc.

Division B. Thysanuradelphia.

Superorder 1. Panthysanura.

Orders: Lepismatoida, Machiloida, etc. The Campodeioida (including the Japygids) may be included here or may be placed in a separate superorder.

SUBCLASS II. Pterygota.

Division A. Archipteradelphia.

Superorder 1. Panpalæodictyoptera.

Orders: Palæodictyoptera and a number of fossil forms.

Superorder 2. Panarchiptera.

Orders: Protephemeroida, Ephemeroida (Archiptera), Odonata, etc.

Division B. Orthopteradelphia.

Superorder 1. Panisoptera.

Orders: Protoblattoida, Blattoida, Mantoida (possibly a part of the Blattid order), Isoptera, etc.

Superorder 2. Panorthoptera.

Orders: Protorthoptera, Orthoptera (s. str.), Phasmoida, Dermaptera, etc. The preceding superorder might be included in this superorder also.

Superorder 3. Panplecoptera.

Orders: Plecoptera, Embiidina, etc.

Division C. Neuropteradelphia.

Superorder 1. Panhemiptera.

Orders: Psocoida, Hemiptera (including Homoptera), Thysanoptera, Anoplura, Mallophaga, etc.

Superorder 2. Panneuroptera.

Orders: Neuroptera, Hymenoptera, Coleoptera, etc. The Strepsiptera may also be included here.

Superorder 3. Panmecoptera.

Orders: Mecoptera, Diptera, Siphonaptera, Trichoptera, Lepidoptera, etc. This superorder might be included in the preceding one.

## BIBLIOGRAPHY.

For a discussion of the origin and interpretation of the parts of the maxillæ, see article by Crampton, 1922, Proc. Ent. Soc. Washington, 24, p. 65. Good general descriptions of the parts are given in

Packard's "Textbook"; Berlese's "Gli Insetti"; an article by Crampton, 1921, Annals Ent. Soc. America, 14, p. 65; and the excellent article on the mandibulate insects by Waterhouse, 1895. The voluminous publications of Chatin are of less value. For the special groups, the following are of interest.

ANOPLURA.—CHOLODKOVSKY, Zool. Anz., 27, p. 120; CUMMINGS, Ann. Mag. Nat. Hist., 15, p. 256; ENDERLEIN, Zool. Anz., 28, p. 121, 220, 626; HARRISON, Proc. Cambr. Phil. Soc., 18, p. 207; PAWLOWSKY, Zeit. Wiss. Insekten Biol., 1906, p. 156, 198; PEACOCK, Parasitology, 1918, p. 98, etc.

APTERYGOTA.—Various papers by BOERNER; ESCHERICH, Zoologica, 18; HOFFMAN, Zeit. Wiss. Zool., 80, p. 598; FOLSOM, Bull. Mus. Comp. Zool., 35, p. 7, and 36, p. 87; IMMS, L. M. B. C. Memoir, 13; STUMMER-TRAUNFELS, S. B. Ak. Wien, Math. Kl., 100, p. 216; PRELL, Zoologica, 1913, p. 1 (Heft 64); UZEL, Zool. Anz., 20.

COLEOPTERA.—Various papers by VERHOEFF; BUGNION, Rev. Suisse Zool. Gen., 19, p. 135; DEEGENER, Z. W. Z., 68; EICHELBAUM, Allg. Zeit. Ent., 1902, p. 225; HADDON, Proc. Zool. Soc., 1915, p. 77; HARDENBERGH, Trans. Wis. Acad. Sci., 15, p. 548; various papers by D'ORCHYMONT, PAULY, SMITH, and others.

DERMAPTERA.—CRAMPTON, Ann. Ent. Soc. America, 14, p. 65; YUASA, Jour. Morphology, 1922; VERHOEFF, Nova Acta, etc., 84, p. 5.

DIPTERA.—Various papers by FREY, BECHER, HANSEN, DIMMOCK, KELLOGG, MEINERT, WESCHE, and others listed in the fine paper by PETERS, Ill. Biol. Monographs, 3, p. 7. The maxilla of *Pangonia* here figured is from TETLEY, Bull. Ent. Res., 7, p. 253.

EPHEMERIDA.—EATON's "Monograph"; also papers by MORGAN and others.

HEMIPTERA.—Various papers by SNODGRASS on *Cicada;* BUGNION and POPOFF, Arch. Zool., 1911, p. 643; GEISE, Thesis, 1883; HEYMONS, Ent. Nachr., 22, p. 173; also Nova. Acta, 1899, p. 353; LEON, Thesis, 1887; MEEK, Kans. Univ. Sci. Bull., 2, 1903; MUIR & KERSHAW, Psyche, 18, p. 1; TOWER, 1914, gives literature.

HYMENOPTERA.—Various papers by CHATIN; DEMOLL, Z. W. Z., 1909, Vol. 92, p. 187; VAN DYNE, Hawaiian Ent. Soc., I, p. 19; EICHOFF, Berlin Ent. Zeit., 1864; KIRMAYER, Morph. Jahrb., 39, p. 1; MACGILLIVRAY, Ann. Ent. Soc. America, 5, p. 231; SNODGRASS on honey-bee; ZANDER, and others.

ISOPTERA.—BUGNION, Ann. Ent. Soc. France, 83, p. 351, etc.; CRAMPTON, Annals Ent. Soc. America, 14, p. 65; IMMS, HOLMGREN, and others.

LEPIDOPTERA.—DIMMOCK, Psyche, 3, 1880; GENTHE, Zool. Jahrb., Abt. Syst., 10, p. 373; KELLOGG, Amer. Nat., 29, p. 546; KIRBACH, Zool. Anz., 1883, p. 553; MOSHER, Jour. Ent. Zool., 7, p. 98; WALTER, Jen. Zeit. Naturw., 18, p. 121, also p. 751.

MALLOPHAGA.—Boll. Soc. Nat., 23, p. 76; CUMMINGS, Proc. Zool. Soc., 1913, p. 128; SNODGRASS, Trans. Amer. Ent. Soc., 1905, p. 297, etc.

MECOPTERA.—Excellent paper by OTANES, Ann. Am. Ent. Soc., 1923; CRAMPTON, l.c., MIYAKE, etc.

NEUROPTERA.—Paper by CRAMPTON, cited above.

ODONATA.—Papers by BOERNER, also BUTLER, Trans. Amer. Ent. Soc. Phila., 30, p. 111.

ORTHOPTEROIDS.—Best paper is by YUASA, cited above, also paper by CRAMPTON, cited above and in Psyche, 23, p. 83, treats of several types; BUGNION, Bull. Ent. Suisse, 11, Fasc. 7, and Ann. Sci. Nat. Zool., 3, 1921, p. 41, describes blattids; MANGAN, Proc. Roy. Irish Soc., 1908, p. 1, same; VERHOEFF, l.c.; NININGER, Psyche, 22, p. 13; also papers by MUHR, WOLTER, and others.

PLECOPTERA.—Papers by SMITH, KLAPALEK, etc.

PSOCIDS.—BURGESS, Proc. Bost. Soc. Nat. Hist., 19, p. 291, and various papers by ENDERLEIN, SILVESTRI, etc.

SIPHONAPTERA.—Various papers by HEYMONS; JOURDAIN, Bull. Soc. Ent. France, 1899, p. 204; OUDEMANS, Nov. Zool., 16, p. 133, etc.

THYSANOPTERA.—BOHLS, Thesis; GARMAN, Amer. Nat., 1896, p. 591; excellent study by PETERSON, Ann. Ent. Soc., 1915, p. 20.

TRICHOPTERA.—CHATIN, Bull. Soc. Philom., 1891, p. 53; CUMMINGS, Ann. Mag. Nat. Hist., 1914, p. 22, and 1913, p. 308; LUCAS, Arch. Naturg., 59, p. 285; ULMER, Zool. Anz., 28, p. 56, etc.

## ABBREVIATIONS.

*a*, laciniadentes, or apical tooth-like processes.
*b*, midappendix, or modified lacinula.
*bc*, basicardo, or basal sclerite of cardo.
*be*, endite of second segment of crustacean appendage.
*bg*, basigalea, or basal segment of galea.
*bl*, basilacinia, or basal sclerite of lacinia.
*bm*, basimaxilla, or basal plate of maxilla.
*bp*, basipodite, or second segment of crustacean appendage.
*bs*, basistipes, or basal sclerite of stipes.
*ca*, cardo.
*cc*, cardocondyle.
*cm*, cardomargin.
*cp*, coxopodite, or first segment of crustacean appendage.
*cpr*, cardoprocess.
*crp*, carpopodite, or fifth segment of crustacean limb.
*ct*, cardotendons.
*dc*, disticardo, or distal sclerite of cardo.
*dg*, distigalea, or distal segment of galea.
*dig*, digitus.
*dl*, distilacinia, or distal sclerite ("head") of lacinia.
*dp*, dactylopodite, or seventh segment of crustacean limb.
*ds*, dististipes, or distal sclerite of stipes.
*en*, endopodite, or palpus.
*eng*, endogalea, or inner lobe of galea.
*eus*, eustipes.
*exg*, exogalea, or outer lobe of galea.
*f*, "fulturæ."
*ga*, galea.

*hp*, hypopharynx.
*ie*, endite of fourth segment of crustacean appendage.
*il*, interlora, or bar connecting maxilla with hypopharynx.
*ip*, ischiopodite or third segment of crustacean limb.
*la*, lacinia.
*le*, lacinulæ (modified spines or setæ).
*lf*, laciniafer, or lacinia-bearing sclerite.
*li*, labium.
*md*, mandible.
*me*, meropodite, or fourth segment of crustacean limb.
*mm*, micromere, or small palpal segment.
*mp*, maxillary palpus (endopodite).
*ms*, mediostipes, or median area of stipes.
*mx*, maxilla.
*pas*, parastipes.
*pf*, palpifer.
*pl*, paralora.
*pp*, propodite, or sixth segment of crustacean limb.
*ppr*, palpiprocess, or process of basal segment of palpus.
*so*, sense organ on third segment of maxillary palpus.
*st*, stipes.

## EXPLANATION OF PLATES XII–XVII.

All figures are of the insect's right maxilla drawn from the posterior (ventral) surface. The following figures were redrawn from others: Figs. 6, 8, 11, 12, 14, 15, 20, 21, 24, and 25 from Boerner; 7 and 9 from Escherich; 13 from Stummer-Traunfels; 17 from Racovitza; 19 from Imms; 22 from Prell; 29 from Desneux; 66 from Tetley; 76 from Enderlein; 72 from Peterson, and 74 from Snodgrass.

FIG. 1. Lines of descent of insects and their arthropodan relatives.
FIG. 2. Maxilla of amphipod crustacean *Gammarus ornatus*.
FIG. 3. Maxilliped of *Gammarus* sp.
FIG. 4. Maxilla of larval Neuropteron *Sialis* sp.
FIG. 5. Maxilla of larval Coleopteron *Passalus* sp.
FIG. 6. Distilacinia of Sminthurid Collembolan *Sminthurides serroseta*.
FIG. 7. Lacinia of Lepismatid Apterygotan *Nicoletia neotropicalis*.
FIG. 8. Distilacinia of Sminthurid Collembolan *Allacma fusca*.
FIG. 9. Lacinia of Lepismatid Apterygotan *Assmuthia spinossisima*.
FIG. 10. Maxilla of *Lepisma* sp.
FIG. 11. Distilacinia of the Podurid Collembolan *Anurida maritima*.
FIG. 12. Same from another view.
FIG. 13. Maxilla of Apterygotan *Campodea staphylinus*.
FIG. 14. Distilacinia of Entomobryid Collembolan *Pogognathus plumbeus*.
FIG. 15. Distilacinia of Apterygotan *Machilis* sp.
FIG. 16. Maxilla of Chilopod *Scolopendra* sp.
FIG. 17. Endite of maxilla of Crustacean *Trichoniscus corsicus*.
FIG. 18. Maxilla of *Tomocerus flavesceus* (Entomobryid Collembolan).
FIG. 19. Maxilla of Podurid Collembolan *Anurida maritima*.
FIG. 20. Palpifer, galea, and palpus of maxilla of Podurid Collembolan *Tetrodontophora bielanensis*.

FIG. 21. Maxilla of same.
FIG. 22. Maxilla of Proturan *Eosentomon* sp.
FIG. 23. Maxilla of Apterygotan *Japyx* sp.
FIG. 24. Distilacinia of Podurid Collembolan *Tetrodontophora bielanensis.*
FIG. 25. Second endite of maxilla of Crustacean *Gammarus* sp.
FIG. 26. Maxilla of Apterygotan *Machilis* sp.
FIG. 27. Leptinid Coleopteron *Leptinus testaceus.*
FIG. 28. Hemimerid Dermapteron *Hemimerus talpoides.*
FIG. 29. Leptinid Coleopteron *Platypsyllus castoris.*
FIG. 30. Immature Odonatan *Æschna umbrosa.*
FIG. 31. Immature Ephemerid *Oniscigaster* sp.
FIG. 32. Tettigoniid Orthopteron *Peranabras scabricollis.*
FIG. 33. Grylloid Orthopteron *Gryllus* sp.
FIG. 34. Grylloid Orthopteron *Gryllotalpa* sp.
FIG. 35. Dermapteron *Anisolabis maritima.*
FIG. 36. Staphylinid Coleopteron.
FIG. 37. Cicindelid Coleopteron *Cicindela* sp.
FIG. 38. Zorotypoid Psocid *Zorotypus snyderi.*
FIG. 39. Phasmid Orthopteroid *Timema* sp.
FIG. 40. Embiid *Oligotoma* sp.
FIG. 41. Grylloblattid Orthopteron *Grylloblatta campodeiformis.*
FIG. 42. Tridactyloid Orthopteron *Rhipipteryx atra.*
FIG. 43. *Tettix* sp.
FIG. 44. Plecopteron *Eusthenia* sp.
FIG. 45. Isopteron *Termes* sp. from Belgian Congo.
FIG. 46. Immature Plecopteron *Perla* sp.
FIG. 47. Blattid *Periplaneta americana.*
FIG. 48. Mantid *Stagmomantis carolina.*
FIG. 49. Neuropteron *Corydalis cornutus.*
FIG. 50. Neuropteron *Ululodes* sp.
FIG. 51. Neuropteron *Nemoptera* sp.
FIG. 52. Mecopteron *Bittacus* sp.
FIG. 53. Mecopteron *Panorpodes* sp.
FIG. 54. Hymenopteron *Lyda hypotrophica.*
FIG. 55. Hymenopteron *Chlorion ichneumonium.*
FIG. 56. Hymenopteron *Pelecinus* sp.
FIG. 57. Phasmid *Anisomorpha* sp.
FIG. 58. Hymenopteron *Xyela* sp.
FIG. 59. Hymenopteron *Macroxyela* sp.
FIG. 60. Mecopteron *Panorpa* sp.
FIG. 61. Strepsipteron *Xenos* sp.
FIG. 62. Trichopteron *Plectrotarsus gravenhorsti.*
FIG. 63. Trichopteron *Dipseudopsis* (from the Himalayas).
FIG. 64. Trichopteron, *Neuronia semifasciata.*
FIG. 65. Siphonapteron *Pulex* sp.

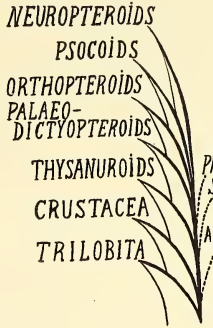



Fig. 1

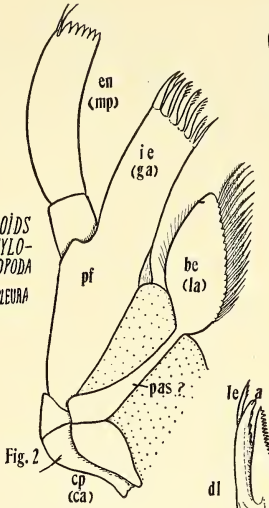



Fig. 2

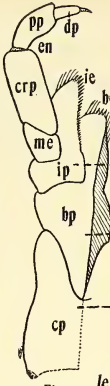



Fig. 3

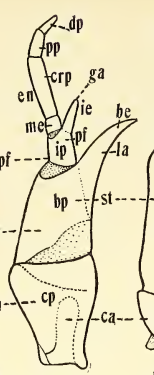



Fig. 4

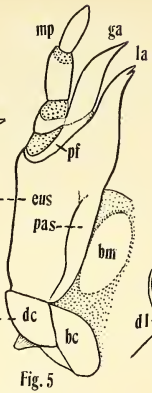



Fig. 5


Fig. 6


Fig. 8

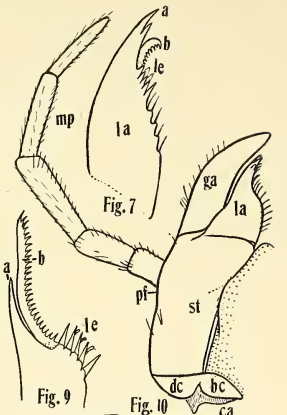



Fig. 7

Fig. 9

Fig. 10

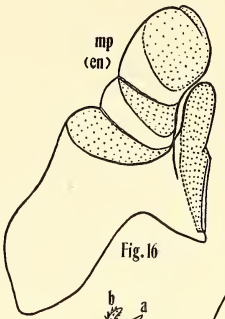



Fig. 16

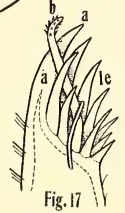



Fig. 17

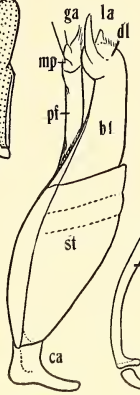



Fig. 18

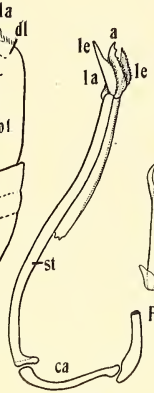



Fig. 19


Fig. 20

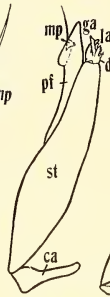



Fig. 21

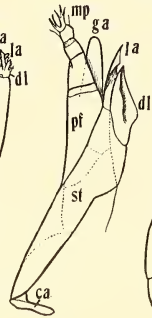



Fig. 22

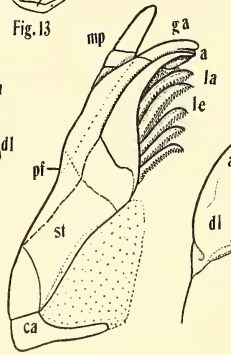



Fig. 23

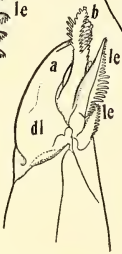



Fig. 24


Fig. 25




Fig. 15

Fig. 26




Fig. 11

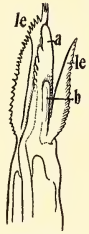



Fig. 12

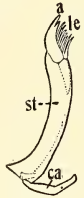



Fig. 13

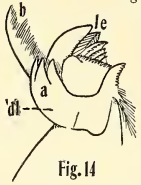
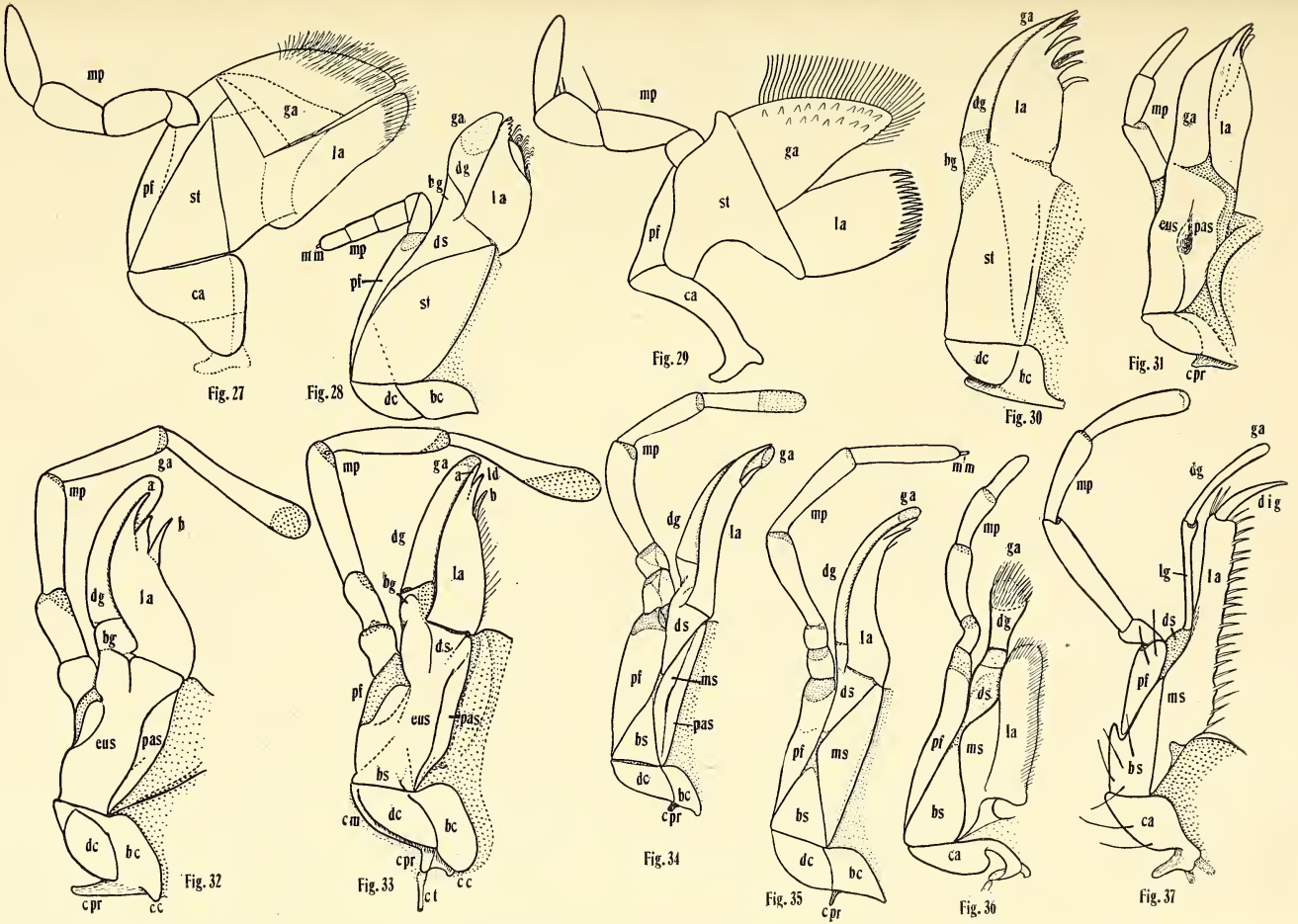



Fig. 14

MAXILLAE OF INSECTS.




MAXILLAE OF INSECTS.

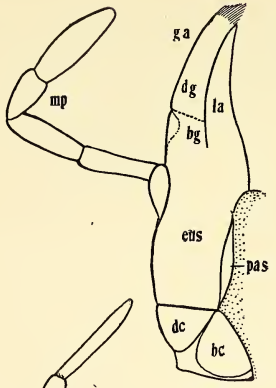


Fig. 38

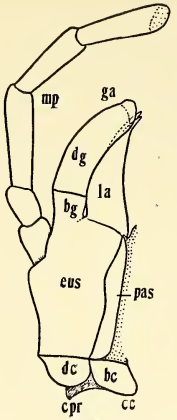


Fig. 39

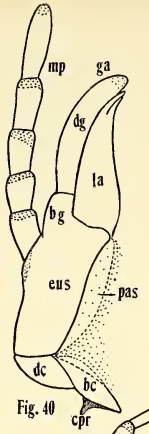


Fig. 40

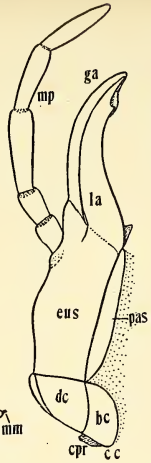


Fig. 41

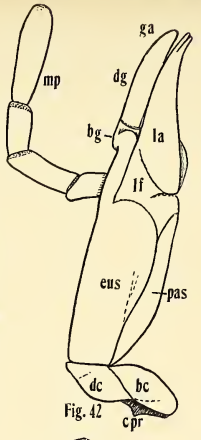


Fig. 42

Fig. 43

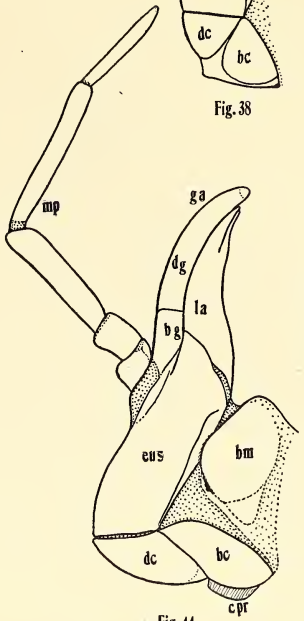


Fig. 44

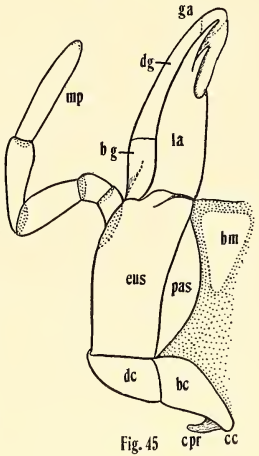


Fig. 45

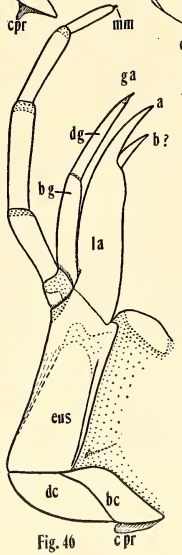


Fig. 46

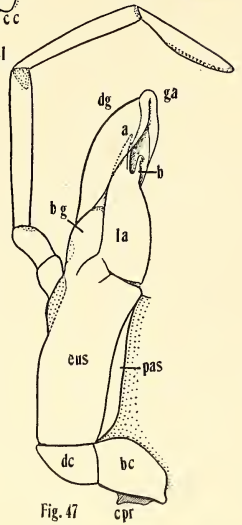


Fig. 47

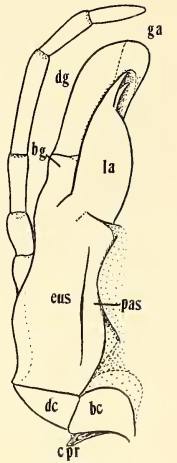


Fig. 48

MAXILLAE OF INSECTS.

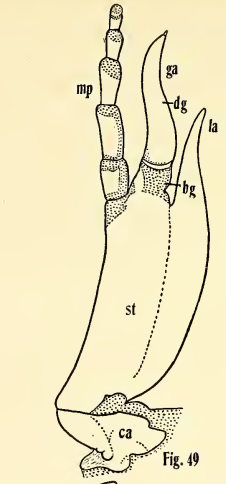


Fig. 49

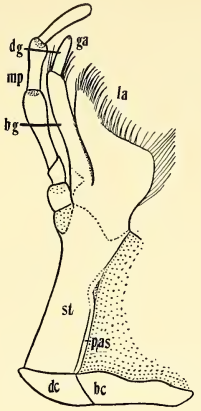


Fig. 50

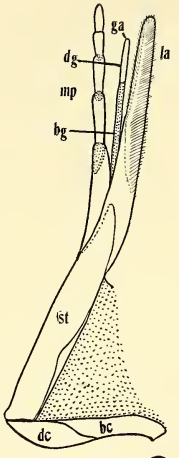


Fig. 51

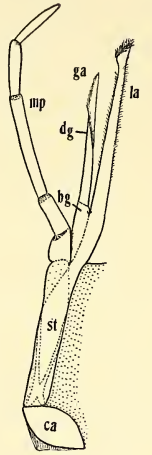


Fig. 52

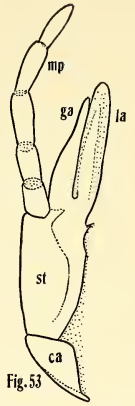


Fig. 53

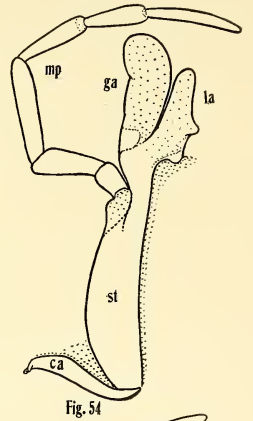


Fig. 54

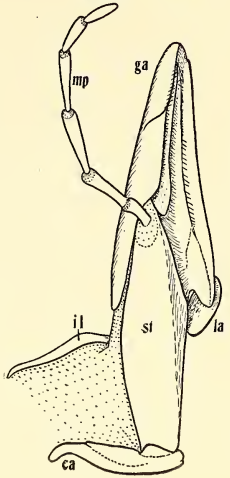


Fig. 55

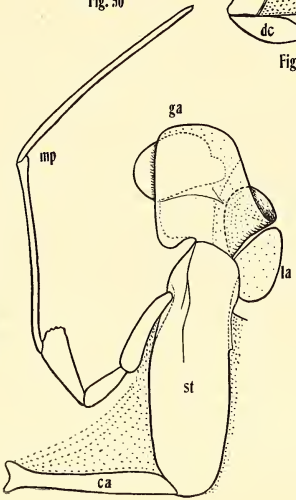


Fig. 56

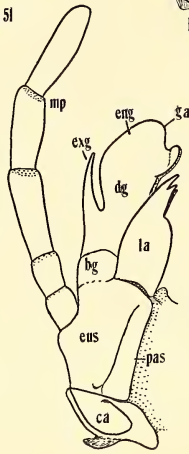


Fig. 57

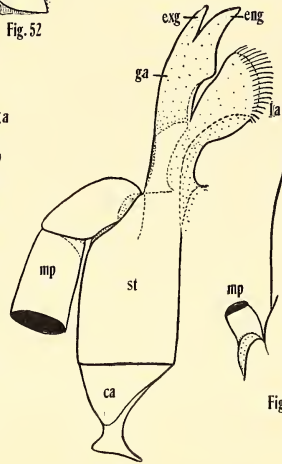


Fig. 58

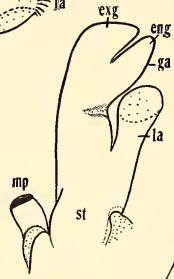


Fig. 59

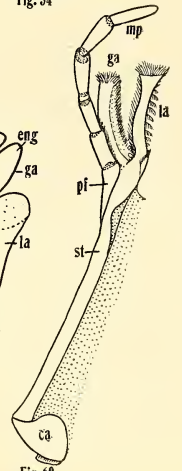
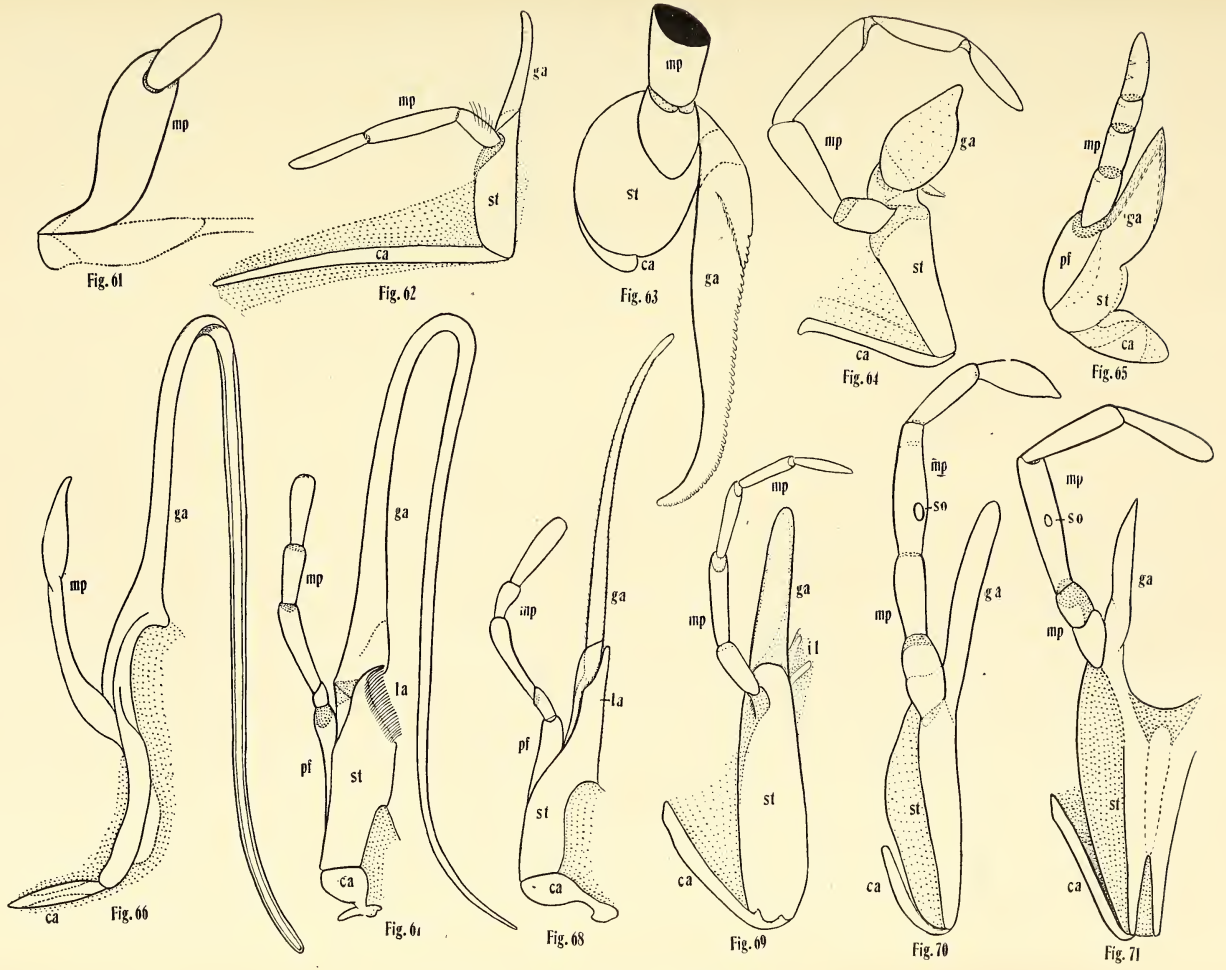
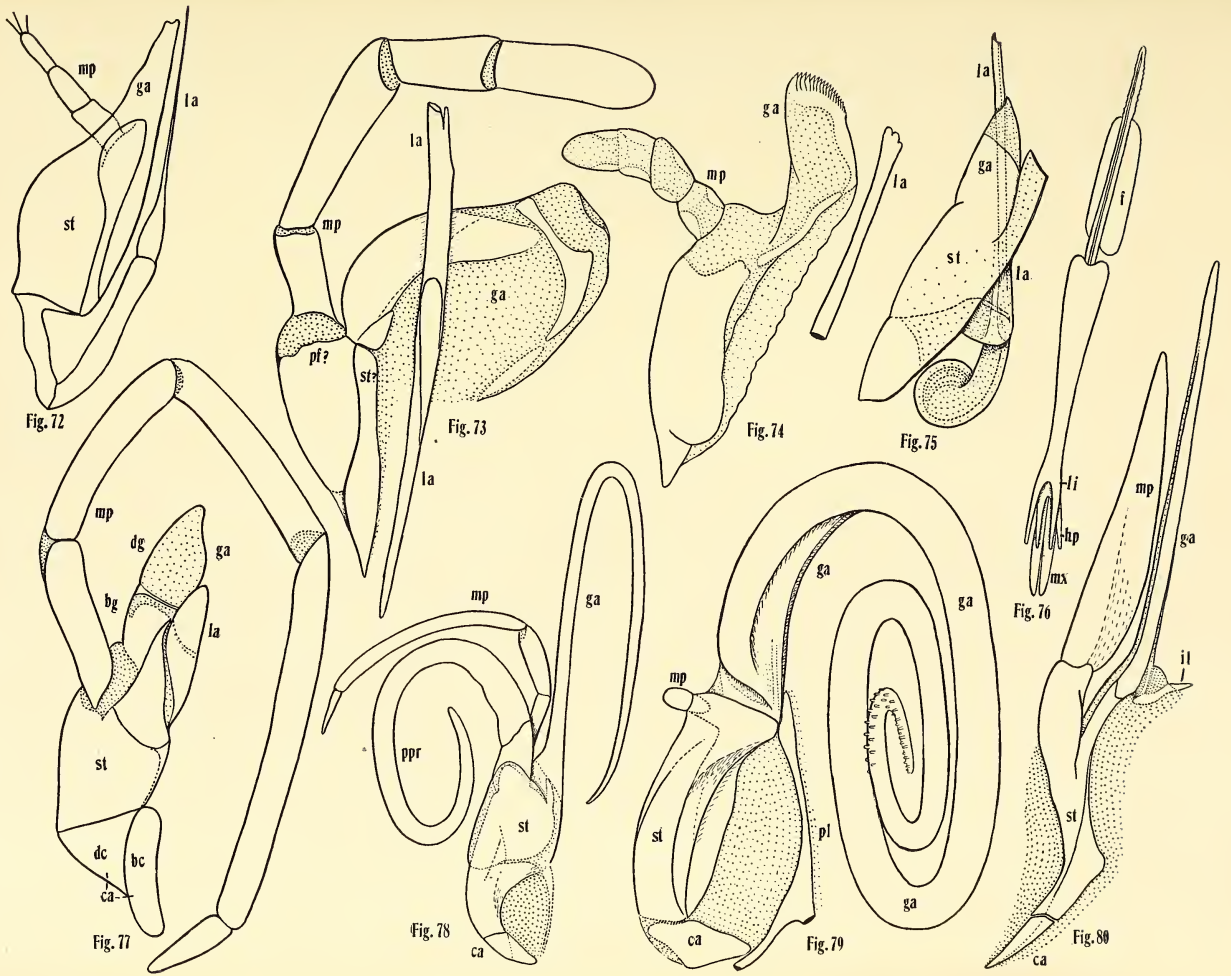


Fig. 60

MAXILLAE OF INSECTS.




MAXILLAE OF INSECTS.




MAXILLAE OF INSECTS.

Fig. 66. Tabanid Dipteron *Pangonia longirostris.*
Fig. 67. Meloid Coleopteron *Nemognatha piezata.*
Fig. 68. Rhipiphorid Coleopteron *Rhipiphorus dimidiatus.*
Fig. 69. Hymenopteron *Bracon liberator.*
Fig. 70. Mecopteron *Nannochorista dipteroides.*
Fig. 71. Dipteron *Asyndulum montanum.*
Fig. 72. Thysanopteron *Heliothrips.*
Fig. 73. Psocid *Psocus venustus.*
Fig. 74. Mallophagan, *Lœmobothrium gypsis.*
Fig. 75. Homopteron *Ptyelus flavescens.*
Fig. 76. Anopluran *Pediculus vestimenti* (maxilla, hypopharynx, and labium).
Fig. 77. Lepidopteron *Micropteryx* (*Eriocephala*) *sepella.*
Fig. 78. Lepidopteron *Tegiticula yuccasella.*
Fig. 79. Lepidopteron *Ctenucha virginica.*
Fig. 80. Dipteron *Tabanus* sp.

## QUARTER CENTURY OF SPECIES OF TENTHREDO (HYMENOPTERA).[1]

By Alex. D. MacGillivray,

Urbana, Ill.

With many species of Hymenoptera where the color forms an important part in distinguishing the species, the males are frequently differently colored from the females. Unless specimens are taken in copulation or the environmental conditions are such that the two sexes can be identified without question, it necessitates the describing of the males and females under different names. Norton and others have tried to combine the two sexes from general appearances, but I believe it is much better to make a synonym than to make the mistake of combining males and females although quite similar in general appearance, that do not belong together. Because of this inability to recognize the two sexes of the same species, the species of Tenthredo must be treated in this way.

**Tenthredo remea** new species.

Female. Body black with the labrum, clypeus, mandibles, a spot on each occipital orbit, a dot at the meso-caudal angles of the compound eyes, collar

[1] Contributions from the Entomological Laboratories of the University of Illinois, No. 77.

broadly, tegulæ, spot above posterior coxæ, most of basal plates, ends of coxæ, trochanters, femora except a bar on upper side of distal end, tibiæ, and tarsi, yellow; clypeus roundly emarginate; antennæ with the first segment of the flagellum longer than the second and third together, the second longer than the third; frontal furrow broad, deep, with a median carina, extending to the median ocellus; head polished; mesonotum and mesoscutellum finely punctured; abdomen depressed; saw-guides short, upper margin oblique, ventral margin rounded, distal end obliquely broadly rounded; wings yellowish hyaline, veins brown, stigma and costa paler. Length, 14 mm.

*Habitat:* Corvallis, Oregon; received from A. L. Lovett, Finch collector.

This is a beautiful large species, the *subcærulea* of MacGillivray.

**Tenthredo remora** new species.

Male. Body black with the labrum, clypeus, mandibles, genal orbits, extending broadly onto the occipital orbits, a dot at meso-caudal angle of each compound eye, the collar, the tegulæ, the mesopleura, pectus, the metapleura entirely, the basal plates, and the legs except a dot or bar on the distal part of the upper side, dirty white; abdomen rufous, approximating remainder of body in shade on ventral aspect; clypeus squarely emarginate; antennæ with the first segment of the flagellum longer than the second, shorter than the second and third together, the second longer than the third; wings hyaline, veins and stigma pale. Length, 12 mm.

*Habitat:* Corvallis, Oregon; F. C. Shefard, collector.

This species appears something like *magnata.*

**Tenthredo reduvia** new species.

Female. Body black with the labrum, clypeus, mandibles, genal orbits, extending broadly onto the occipital orbits, continued as a line along the frontal orbits, dilated and extending beyond the meso-caudal angles of the compound eyes, collar broadly, tegulæ, a spot on the mesal margin of each lateral lobe of the mesonotum, the mesoscutellum, a broad oblique band on the metapleura, a spot above the posterior coxæ, the sides of the basal plates, the coxæ and trochanters, becoming rufous on the posterior, and the lateral margins of the first three abdominal segments, yellowish-white; the legs rufous except the parts named and an indefinite band on the proximal part of the profemora and protibiæ and also beyond above the third segment of the flagellum, indistinctly rufous; antennæ with the first segment of the flagellum long, not as long as the subequal second and third segments together; clypeus narrowly emarginate; frontal furrow broad with a mesal carina; head polished; saw-guides with the dorsal and ventral margins converging, the distal portion obliquely rounded; wings hyaline, veins brown, costa and stigma pale. Length, 10 mm.

*Habitat:* Corvallis, Oregon; received from A. L. Lovett, Foster collector

This species is near *scævola* Cresson.

**Tenthredo retosta** new species.

Male. Body black with the labrum, clypeus, mandibles, genal orbits, occipital orbits, frontal orbits for one-half their length, connected ventrad of the antennæ, a dot at the meso-caudal angle of each compound eye, collar, sides of pronotum, tegulæ, mesopleura, pectus, metapleura, spot above posterior coxæ, sides of basal plates, legs except a black line on the protibiæ, protarsi, mesotibiæ, mesotarsi, and upper side of metacoxæ, metatrochanters, metatibiæ, and all of the metatarsi, yellow-white; venter of the abdomen, yellow-white, extending along each side as a narrow margin onto the dorsal aspect; antennæ with second and third segments of flagellum subequal, together longer than the first; clypeus roundly truncate; frontal furrow broad and shallow; wings hyaline, veins and stigma brownish. Length, 8 mm.

*Habitat:* ?Corvallis, Oregon; received from A. L. Lovett.

**Tenthredo resima** new species.

Female. Body black with the labrum, clypeus, mandibles, genal orbits, extending broadly onto the occipital orbits and as a line along the frontal orbits, dilated at the meso-caudal angles of the compound eyes, connected by a transverse spot below the antennæ, the collar, the tegulæ, the mesoscutellum, a broad band on the mesopleura, spot on the metapleura, a spot above the metacoxæ, the sides of the basal plates, the coxæ and trochanters almost completely, and the sides of abdominal segments one to three, yellow; the legs, except an indefinite band on the upper side of the proximal parts of the profemora, and the abdomen beyond the third segment, rufous; clypeus squarely emarginate; frontal furrow deep, V-shaped, without mesal carina; antennæ with second and third segments of the flagellum elongate, subequal, together longer than the first segment; saw-guides with the dorsal margin straight, ventral margin straight on cephalic portion, caudal rounding and oblique; wings hyaline, veins brown, costa and stigma pale. Length, 10 mm.

*Habitat:* Mary's River, Corvallis, Oregon; received from A. L. Lovett.

**Tenthredo ripula** new species.

Male. Body black with the labrum, clypeus, mandibles, genal orbits, occipital orbits broadly, extending onto vertical orbits, connecting by a narrow line from genal orbits to frontal orbits, area between and above antennæ, extending as two lines along the sides of the frontal furrow, caudal margin of the head, prothorax, triangular spot on each half of the median lobe of the mesonotum, mesoscutellum, metascutellum, lateral and ventral aspects of the thorax, ventral aspect of abdomen, extending on each side as a margin on dorsal aspect, legs, except a black line on femora, tibiæ, and tarsi, yellowish-white; clypeus roundly emarginate; frontal furrow deep, concave; wings hyaline, veins black, costa and stigma white. Length, 9 mm.

*Habitat:* Corvallis, Oregon; received from A. L. Lovett.

**Tenthredo rima** new species.

Male. Body black with the labrum, clypeus, mandibles, the genal orbits, extending broadly onto the occipital orbits, narrowly onto the frontal orbits, a long spot at the meso-caudal angle of each compound eye, the collar, tegulæ, the ventral margin of the pronotum, band on the mesopleura, pectus, band on metapleura, spot above posterior coxæ, sides of basal plates, venter of abdomen, extending as a narrow margin onto the dorsal aspect, and legs except a black band above, broader on coxæ, yellow-white; clypeus roundly emarginate; antennæ with the first segment of the flagellum subequal to the subequal second and third segments together; frontal furrow broad and shallow; wings hyaline, veins brownish, costa and stigma pale. Length, 10 mm.

*Habitat:* Corvallis, Oregon; received from A. L. Lovett, Scott, collector.

**Tenthredo rabida** new species.

Female. Body black with the labrum, clypeus, mandibles, collar, tegulæ, spot above posterior coxæ, sides of basal plates, and the underside of the front and middle tibiæ, greenish-white; abdomen beyond the third segment, including the saw-guides, except their margins, rufous, also the distal segment of all the tarsi; clypeus broadly roundly emarginate; antennæ with the first segment of the flagellum longer than the second but distinctly shorter than the subequal second and third segments together; head polished, frontal furrow deep, irregular; saw-guides with the dorsal margin straight, the ventral margin straight, becoming convex and convexly rounded at apex; wings smoky, the veins including the costa, black, the stigma paler. Length, 12 mm.

*Habitat:* Mary's Peak, Corvallis, Oregon; L. G. Geniner, collector.

This species runs in tables to *semirufa* Norton.

**Tenthredo restricta** new species.

Male. Body black with the labrum, clypeus, mandibles, area between the antennæ, dot above each antenna, genal orbits, lower half of occipital orbits, dot at summit of eyes, collar, tegulæ, prothorax for most part, mesoscutellum, mesopleura and metapleura for most part, mesosternum, spot above posterior coxæ, sides of basal plates, a mesal dot on the tergum of the first abdominal segment, a broad band upon the caudal part of the second to fourth abdominal terga, greater part of venter of abdomen, prothoracic and mesothoracic legs, except a black line on femora and tibiæ, tarsi black, metathoracic legs with the coxæ, and underside of the trochanters and femora, yellow; abdomen with fifth and following segments rufous; antennæ with third segment longer than fourth, fourth and fifth subequal; clypeus deeply emarginate; frontal furrow with sides converging below; wings hyaline, veins and stigma and costa black. Length, 11 mm.

*Habitat:* Alsea, Oregon; A. L. Lovett, collector.

This species runs to *nigritibialis* from which it is easily separated.

**Tenthredo ralla** new species.

Female. Body black with the labrum, clypeus, mandibles, genal orbits, extending onto the frontal orbits and broadly onto the occipital orbits, the collar, the tegulæ, the ventral margin of the pronotum, the mesopleura broadly, the metapleura, a spot above the posterior coxæ, the sides of the basal plates, the coxæ, the trochanters, and the proximal portion of the femora, yellowish-white; the pectus for the most part, extending onto the pleural pale marks, the remainder of the legs, and the abdomen beyond the middle of the first segment, rufous; clypeus narrowly shallowly emarginate; frontal furrow shallow, irregular, not extending to the median ocellus; saw-guides with the dorsal margin straight, the ventral slightly convex, the distal end rounded and truncate; the wings yellowish, the veins including the costa, yellowish, stigma blackish. Length, 12 mm.

*Habitat:* Mary's Peak, Corvallis, Oregon; A. L. Lovett, collector.

This species has many characteristics in common with *signata* Norton.

**Tenthredo repleta** new species.

Female. Body black with the four or five distal segments of the antennæ, the underside of mesotibiæ and metatibiæ, and all the tarsi for the most part, dirty white; antennæ with the first segment of the flagellum a little longer than the second, the second and third subequal; clypeus roundly emarginate; the mesopleura and notum punctured; the saw-guides with the dorsal and ventral margins slightly converging, the distal end roundly truncate; the wings smoky, the veins including the costa and stigma, black. Length, 13 mm.

Male. The two sexes are indistinguishable except that the male is more slender and shorter. Length, 11 mm.

*Habitat:* Mary's Peak, Corvallis, Oregon; A. L. Lovett and L. G. Gontner, collectors.

This species appears to be near *nigricollis* Kirby.

**Tenthredo reflua** new species.

Male. Body black with clypeus, labrum, mandibles, spot beneath antennæ, genal orbits, lower half of occipital orbits, collar, tegulæ in part, pronotum in great part, oblique band on mesopleura, mesosternum broadly, separated from mesopleura by a narrow black band, line on metapleura, spot above posterior coxæ, sides of basal plates, some of the cephalic sterna, prothoracic coxæ, remainder of prothoracic legs beneath, mesothoracic legs beneath except their tarsi which are black, and the coxæ and trochanters and a small proximal portion of the metathoracic femora, yellow; distal part of the metafemora, their tibiæ, and tarsi beneath, and the abdomen beyond the third segment, rufous; the second and third abdominal terga each with a mesal rufous spot; antennæ with third segment longer than fourth, fourth and fifth subequal; frontal fur-

row narrow and deep; wings hyaline, slightly smoky, veins and stigma and costa and stigma blackish. Length, 12 mm.

*Habitat:* Bellfountain, Oregon; A. L. Lovett, collector.

This species is similar to *variegata* but larger and stouter.

**Tenthredo rabiosa** new species.

Female. Body black with the labrum, clypeus, front, mandibles, genæ, orbits, lower half of occipital orbits, facial orbits broadly, dilated above, a dot above each antenna, pronotum, tegulæ, a triangular mark on each lateral lobe of mesonotum, the two subadjacent, mesoscutellum, a broad band on each mesopleuron, a line on each metapleuron, a spot above the metacoxæ, the sides of the basal plates, a band on the lateral margin of abdominal segments one to three, the coxæ and trochanters, except partially above, yellow; abdomen beyond the third segment, legs beyond trochanters, and antennæ beyond third segment, rufous; clypeus deeply emarginate; antennæ with third segment nearly as long as the fourth and fifth together, the fourth longer than the fifth; frontal furrow deep, narrow; head polished, mesonotum finely punctured; saw-guides with dorsal and ventral margins straight, distal end bluntly rounded; wings yellowish hyaline, veins black, costa and stigma yellow. Length, 12 mm.

*Habitat:* Philomath, Oregon; A. L. Lovett, collector.

This species is similar in general appearance to *scævola* Cresson.

**Tenthredo rabula** new species.

Male. Black with the clypeus, labrum, mandibles, spot below antennæ, dot above each antenna, dot at summit of each compound eye, genal orbits, ventral half of occipital orbits, collar, tegulæ, irregular band on mesopleuræ, line on metapleura, spot above posterior coxæ, all the legs except a black line above, the sides of the basal plates, venter of the abdomen, extending as triangular spots onto terga and two sides connected by a fine line along caudal margin, white; antennæ with first segment of flagellum longer than second, second and third subequal; wings hyaline, slightly smoky, veins blackish, stigma in great part pale, costa with proximal half pale and distal half black. Length, 9 mm.

*Habitat:* Corvallis, Oregon; Hunter, collector.

This species runs to *pectoralis*. Its markings are very distinctive for a male.

**Tenthredo racilia** new species.

Male. Body black with the labrum yellow and the legs beyond the trochanters and abdominal segments one to six, rufous; antennæ pale beneath; antenna with first segment of flagellum longer than the second, the second and third subequal; clypeus broadly roundly emarginate; head polished; frontal furrow constricted below, walls not high; wings hyaline, costa and most of

the stigma pale, the medial and radial veins black, the others pale. Length, 10 mm.

*Habitat:* Corvallis, Oregon; L. B. Couch, collector.

This species runs to *rubens.*

**Tenthredo refractaria** new species.

Female. Body black with labrum, two spots on the clypeus, spot on each mandible, spot on each genal orbit, an interrupted line on facial orbits, collar broadly, tegulæ, oval spot on pleura, spot above posterior coxæ, all the coxæ except above, and the trochanters, yellow; the legs beyond the trochanters, except a black ring on distal end of posterior tibiæ, and the abdomen beyond the basal plates, rufous; antennæ rufous beneath, first segment of flagellum longer than second, second longer than third; clypeus roundly shallowly emarginate; saw-guides with the dorsal and ventral margins converging, bluntly pointed at apex; wings hyaline, smoky to yellowish, costa and most of stigma pale, veins black. Length, 12 mm.

*Habitat:* Union County, Oregon; A. L. Lovett, collector.

This species resembles *edwardsii.*

**Tenthredo resupina** new species.

Male. Body black with clypeus, labrum, mandibles, genal orbits, ventral half of occipital orbits, dot at summit of compound eyes, collar, tegulæ, ventral margin of pronotum, band on mesopleura, all the coxæ, and trochanters, femora of the prothoracic and mesothoracic legs, except a black line above, yellow; remainder of legs and the abdomen beyond the basal plates, rufous; antennæ with the first segment of the flagellum slightly longer than the second, the second and third subequal; antennal furrow deep and broad, not constricted below; clypeus deeply emarginate; head polished; thorax sparsely punctate; wings hyaline, yellowish, costa and stigma pale, veins black. Length, 8 mm.

*Habitat:* Bellfountain, Oregon; A. L. Lovett, collector.

This species runs in tables to *scævola* Cress.

**Tenthredo rustica** new species.

Male. Body black with the clypeus, labrum, mandibles, spot between antennæ, dot above each antenna, dot at corner of each compound eye, line on ventral part of facial orbits, genal orbits, ventral half of occipital orbits, line on collar, tegulæ, ventral margin of pronotum, mesosternum, continuous with mesopleura, line on metapleura, spot above posterior coxæ, lateral margins of basal plates, prothoracic legs except black line above, extending to end of tibiæ, tarsi more or less rufous, coxæ and trochanters and femora of mesothoracic legs, except black line above, and coxæ and trochanters of metathoracic legs, except black line above, yellow; mesotibiæ, metafemora in great

part, metatibiæ, and abdomen beyond basal plates, rufous; antennæ with the first segment of the flagellum slightly longer than the second, second and third subequal; wings hyaline, costa and proximal portion of stigma pale, veins black. Length, 10 mm.

*Habitat:* Union County, Oregon; A. L. Lovett, collector.

This species is quite similar to *variegata.*

**Tenthredo reticentia** new species.

Female. Body black with the labrum, clypeus, mandibles, spot on lower portion of occipital orbits, dot at angle of compound eyes, collar, tegulæ, spot above posterior coxæ, sides of basal plates, and the underside of the prothoracic femora more or less, yellow; all the femora, prothoracic and mesothoracic tibiæ, except above, the metathoracic tibiæ entirely and all the tarsi more or less, rufous; antennæ with the first segment of the flagellum nearly as long as the subequal second and third segments together; frontal furrow deep, parallel sides; wings hyaline, veins, costa, and stigma for the most part, black. Length, 10 mm.

*Habitat:* Corvallis, Oregon, E. O. Dalgren, collector and Alsea, Oregon, A. L. Lovett, collector.

This species runs to *nigrifascia.*

**Tenthredo reputina** new species.

Male. Body black with the clypeus, labrum, mandibles, genal orbits, ventral part of facial orbits, connected ventrad of antennæ, dot above each antenna, dot at summit of compound eyes, most of occipital orbits, collar, tegulæ, lateral portion of pronotum in great part, mesoscutellum, mesosternum, extending broadly onto mesopleura, line on metapleura, spot above posterior coxæ, sides of basal plates, and all the legs except a black line above, metatibiæ and metatarsi in part rufous, yellow; abdominal terga, except a narrow cephalic portion, often interrupted at middle of cephalic margin, rufous; abdominal sterna yellow and rufous; antennæ with first segment of the flagellum longer than the second, second longer than third; wings hyaline, veins and stigma and costa black. Length, 9 mm.

*Habitat:* Bellfountain, Oregon; A. L. Lovett, collector.

This may prove to be the male of *magnifica,* although it is differently colored.

**Tenthredo remissa** new species.

Male. Body black with the clypeus, labrum, mandibles, genal orbits, extending slightly onto occipital orbits, dot above each antenna, dot at angles of compound eyes, collar, tegulæ, margins of pronotum, irregular line on mesopleura, pectus, line on metapleura, spot above posterior coxæ, sides of basal plates, coxæ and trochanters and femora of all legs beneath, yellow; tibiæ of

metathoracic legs rufous beneath, their tarsi black, and abdomen beyond middle of second segment, rufous; antennæ with first segment of flagellum longer than second, second and third subequal; frontal furrow shallow; wings hyaline, stigma rufous, costa and veins black. Length, 9 mm.

*Habitat:* Corvallis, Oregon; received from A. L. Lovett.

This species is near *reposita* from which it can be distinguished by the color of the pleura.

**Tenthredo replata** new species.

Female. Body black with the clypeus, labrum, mandibles, genal orbits, extending slightly onto facial and occipital orbits, collar, tegulæ, spot on margins of pronotum, band on mesopleura, line on metapleura, spot above posterior coxæ, sides of basal plates, and all the legs beneath, yellow; abdomen beyond the third segment, rufous; antennæ with the first segment of the flagellum longer than the second, second and third subequal; frontal furrow broad, flat; saw-guides straight above, convex below converging gradually to a blunt point above; wings smoky, stigma rufous, veins and costa black. Length, 10 mm.

*Habitat:* Ormsby County, Nevada; C. F. Baker, collector.

This species is evidently related to *zetes* Kirby.

**Tenthredo resegmina** new species.

Male. Body black with the clypeus, labrum, mandibles, genal orbits, ventral half of occipital orbits, dot at summit of compound eyes, collar, tegulæ, ventral margin of pronotum, band on mesopleura, small line on metapleura, spot above posterior coxæ, pectus, sides of basal plates, coxæ, trochanters, prothoracic and mesothoracic femora, except above, prothoracic tibiæ, except a line above, their tarsi and mesothoracic tibiæ and tarsi suffused with rufous, yellow; metathoracic femora except above, their tibiæ and tarsi, and the abdomen beyond the basal plates, rufous; antennæ with the first segment of the flagellum longer than the second, the second and third subequal; frontal furrow concave; wings yellowish hyaline, stigma and costa rufous, veins black. Length, 9 mm.

*Habitat:* Bellfountain, Oregon; A. L. Lovett, collector.

This species is very similar to *messica.*

**Tenthredo reperta** new species.

Female. Body black with the clypeus, labrum, dot at summit of eyes, inconspicuous, round spot on ventral half of occipital orbits, collar, tegulæ, spot above posterior coxæ, all of front and middle legs beneath, hind tibiæ and tarsi beneath, yellow; antennæ with first segment of flagellum longer than second, second slightly longer than third; saw-guides broad, short, dorsal margin straight, ventral margin and apex broadly convexly rounded, bluntly

pointed; wings hyaline, slightly smoky, stigma rufous, costa and veins black. Length, 10 mm.

*Habitat:* Julietta and Lewiston, Idaho; J. M. Aldrich, collector.

This species is similar to *alphia* but smaller.

**Tenthredo reposita** new species.

Male. Body black with the clypeus, labrum, mandibles, ventral portion of facial orbits, connected between antennæ, dot above antennæ, dot at angles of compound eyes, genal orbits, most of occipital orbits, collar, tegulæ, lateral margin of pronotum broadly, pectus, continuous with and covering most of mesopleura, line on metapleura, spot above posterior coxæ, sides of basal plates, front and middle legs, except a black line above, coxæ and trochanters and femora of metathoracic legs, except above, yellow; metathoracic tibiæ and tarsi except above, and abdomen beyond middle of first segment, rufous; antennæ with first segment of flagellum longer than second, second and third subequal; frontal furrow deep; wings hyaline, costa in great part rufous, stigma and veins black. Length, 9 mm.

*Habitat:* Bellfountain, Oregon; A. L. Lovett, collector.

This species is near *reflua,* from which it can be separated by the coloration of the pleura.

## PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF NOVEMBER 7.

A regular meeting of the New York Entomological Society was held at 8 P.M., on November 7, 1922, in the American Museum of Natural History, Vice-President Harry B. Weiss in the chair, with 12 members present.

On motion by Mr. Woodruff, the Publication Committee was requested to print in each number of the JOURNAL the actual date of issue of the preceding number.

Mr. Davis exhibited 99 species of "Orthoptera of Staten Island" and speaking extemporaneously exhibited a remarkably intimate acquaintance with the taxonomy and life habits of each species. One by one he took up the earwigs, dwelling upon the families of young he had seen, the roaches with descriptions of their nuptial greetings, the sexual differences in the native species, and the conditions under which the introduced species occurred, and the mantids with an account of the successful establishment, through egg masses he had personally distributed, of the Chinese species. Then he spoke of the Walking Stick insects and the curious lack of males of one species and passed next to Katydids and crickets that make the summer and autumn nights songful. The decreasing number of true Katydids and the number of pink

Katydids on Staten Island were noticed, as well as the character of the song. In connection with these stridulating Orthoptera Mr. Davis mentioned Hancock's breeding experiments, Miss Campbell's discovery of the true Katydid colony near Moravian Cemetery on Staten Island, and the great number formerly occurring near the late Louis P. Gratacap's home. The longhorned grasshoppers were next considered, with an explanation of the diminution of the song towards the end of the year; then the crickets with an account of the European species on Staten Island, the song in May of *assimilis* and its long- and short-winged forms.

Mr. Davis pointed out that he was following the succession of families adopted in Morse's New England Orthoptera, which he preferred, though from the much greater number of species treated, Blatchley's Orthoptera of N. E. America was more useful. This led him to speak of taxonomic difficulties which abounded in the short-horned grasshoppers and pygmy grasshoppers that closed his list. Among these he showed a female found 500 feet above the street level in the Woolworth Building, and brought a feminine reporter to his house to inquire into its supposed connection with the Rocky Mountain locust now extinct. All through he was closely followed by the members present who joined in a general discussion at the close of his remarks.

Mr. Leng read for Charles Louis Pollard an account of the "Oviposition of *Monohammus*" recording his observations at Rangeley, Maine, on August 22d. The female gnaws with her mandibles a hole in the bark about the size of a pinhead and no deeper, then presses the short ovipositor into the hole with some force. One egg only is laid in each hole, the operation being complete in about three minutes. Mr. Pollard's observations showed the beetles to be both polygamous and polyandrous.

Mr. Nicolay exhibited *Enoclerus liljebladi* recently described by Wolcott. a northern species heretofore confused with the more southern *E. ichneumoneus,* and stated that he had found it at Bellport, L. I., in July. He also exhibited *Blethisa multipunctata* from Edmonton, Canada.

Mr. Dickerson called attention to a quotation from the British Medical Journal in "Science," referring to a new remedy for trypanosome diseases, especially sleeping sickness. Dr. Bequaert said some such remedies, from lack of chemical permanence, had proved dangerous; and doubtless further careful trial would precede premature announcement of success.

## MEETING OF NOVEMBER 21.

A regular meeting of the New York Entomological Society was held at 8 P.M., on November 21, 1922, in the American Museum of Natural History, Vice-President Harry B. Weiss in the chair, with 13 members present.

Mr. Nicolay under the title "Beetling in the Great Smoky Range of Tennessee" gave an interesting account of his visit with Mr. Frank Mason, of Philadelphia, to Sweetwater, Tenn., on October 2, and of the week following spent in the vicinity, principally in the Mountains of Monroe County, where

the Tellico River Lumber Co.'s operations made food and lodging possible. Traps were set at Tellico Plains, 3,500 feet elevation, and visits made to the surrounding peaks, running up to 6,200 feet, which were reached by logging train. *Cicindela patruela* and *rufiventris, Scaphinotus andrewsi* and *æneicollis, Sphæroderus canadensis* and *bicarinatus* var. and *Nomaretus hubbardi* were found but not in large quantities. The physical discomfort of the trip was considerable and "nothing but wet feet and water down the back" was sometimes the result.

Mr. Notman spoke of "Some Interesting Captures of 1922" resulting from his continued beetle survey of New York State; six weeks in May and June were spent in visiting Nichols, near Owego, Canisteo, Red House, seven miles from Salamanca, Oakfield and Oak Orchard Swamp, near Batavia, and Springwater near Rochester. 6,000 specimens were taken, mounted and studied, adding much to the known distribution within the State.

Mr. Lesieski exhibited a *Cicindela generosa* found July 22d at Oradell which was as coppery red as *formosa.*

Mr. Weiss exhibited Bull. 367 New Jersey Agricultural Experiment Station on "Chemotropism of Mosquitoes" by Willem Rudolfs, in which it was shown that carbon dioxide and ammonia were attractive to them.

# JOURNAL

OF THE

## New York Entomological Society.

Published quarterly by the Society, at Prince & Lemon ts., Lancaster, Pa., and New York City. All communications relating to the JOURNAL should be sent to the Publication Committee. New York En omological Society, American Museum of Natural History, New York City; all subscriptions to the Treasurer, Wm. T. Davis, 146 Stuyvesant Place, New Brighton Staten Is., New York, and all books and pamphlets to the Librarian, Frank E. Watson, American Museum of Natural History, New York City. Terms for subscription, $2.00 per year, strictly in advance. ***Please make all checks, money-orders, or drafts payable to NEW YORK ENTOMOLOGICAL SOCIETY***

Authors of each contribution to the JOURNAL shall be entitled to 25 separates of such contribution without change of form. If a larger number be desired they will be supplied at the following rates, provided notice is sent to the Publication Committee before the page proof has been corrected:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8¢ | for each reprint of a | | | 1 | to | 4 | pp. | article. |
| 10¢ | " | " | " | 5 | " | 8 | " | " |
| 12¢ | " | " | " | 9 | " | 12 | " | " |
| 16¢ | " | " | " | 13 | " | 16 | " | " |
| 20¢ | " | " | " | 17 | " | 20 | " | " |
| 24¢ | " | " | " | 21 | " | 24 | " | " |
| 26¢ | " | " | " | 25 | " | 28 | " | " |
| 28¢ | " | " | " | 29 | " | 32 | " | " |

Two cents additional for each half-tone print. Covers on same paper as the JOURNAL, with printed title page, $1.50 for 50 covers, and 2 cents for each additional cover.

**Authors whose papers are illustrated with text-figures or full-page plates, will be required to supply the electrotypes or pay the cost of making the same by the Journal and also to pay the cost of printing full-page plates on coated paper, when advisable, at the rate of about seven dollars per plate. Halftones must be printed on coated paper.**

# THE NEW YORK ENTOMOLOGICAL SOCIETY

Organized June 29, 1892.—Incorporated June 7, 1893.

---

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Eighth Ave.

Annual dues for Active Members, $3.00.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

---

## Officers for the Year 1923

*President*, HARRY B. WEISS ..... 19 N. 7th Ave., New Brunswick, N. J.

*Vice-President*, FRANK E. LUTZ ..... American Museum of Natural History, New York.

*Secretary*, CHAS. W. LENG ..... Staten Island Museum, St. George, S. I., N. Y.

*Treasurer*, WM. T. DAVIS ..... 146 Stuyvesant Place, New Brighton, Staten Island, N. Y.

*Librarian*, FRANK E. WATSON ..... American Museum of Natural History, New York

*Curator*, A. J. MUTCHLER ..... American Museum of Natural History, New York

*EXECUTIVE COMMITTEE*

H. G. BARBER, GEO. P. ENGELHARDT, L. B. WOODRUFF,
JOS. BEQUAERT, G. C. HALL.

*PUBLICATION COMMITTEE.*

J. D. SHERMAN, JR. E. L. DICKERSON, HOWARD NOTMAN,
C. E. OLSEN.

*AUDITING COMMITTEE.*

E. SHOEMAKER, E. L. BELL, A. S. NICOLAY.

*FIELD COMMITTEE.*

A. S. NICOLAY, JOS. BEQUAERT.

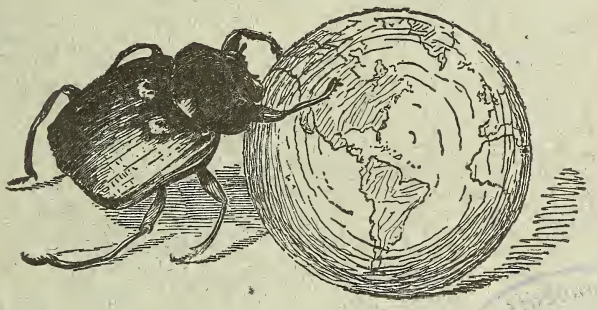
*DELEGATE TO THE N. Y. ACADEMY OF SCIENCES.*

WILLIAM T. DAVIS.

Vol. XXXI. September, 1923 No. 3

# JOURNAL OF THE New York Entomological Society

Devoted to Entomology in General



SEPTEMBER, 1923

Edited by HOWARD NOTMAN

*Publication Committee*

HOWARD NOTMAN J. D. SHERMAN, JR.

E. L. DICKERSON C. E. OLSEN

Published Quarterly by the Society.

LANCASTER, PA. NEW YORK CITY

1923

(Entered April 21, 1904, at Lancaster, Pa., as second-class matter under Act of Congress of July 16, 1894.)

LANCASTER PRESS, INC.

# CONTENTS



NOTICE:—Volume XXXI, Number 2 of the Journal of the New York Entomological Society was published on August 5th, 1923.

JOURNAL

OF THE

New York Entomological Society.

VOL. XXXI. SEPTEMBER, 1923. NO. 3

# A REVISION OF THE TRYPETIDÆ OF NORTHEASTERN AMERICA.

BY VENIA TARRIS PHILLIPS,

CORNELL UNIVERSITY, ITHACA, N. Y.

This work was undertaken to provide keys for the identification of the species of Trypetidæ occurring in northeastern America. This region extends north to the Laurentian Mts., west to include Minnesota and south to embrace Kentucky and Virginia. The generic limits in this family are not well marked, and since no recent general keys are available, for our fauna, this revision may prove useful to entomologists.

For a clear discussion of the family characteristics, as well as for an explanation of technical terms, I refer the reader to Bezzi's recent paper on Indian Trypaneids (1914). Besides the new family name of Trypaneidæ proposed by Bezzi, both Euribiidæ and Tephritidæ have been suggested and used for this group. I prefer however, for the present, to use the old and familiar name of Trypetidæ.

The material used in this family has been largely that of the collection of Cornell University, and I take this occasion to thank the members of the department of Entomology for courtesies extended. I have also been greatly helped by loans of material and suggestions from several entomologists and welcome this opportunity, therefore, to thank J. M. Aldrich, E. T. Cresson, C. W. Johnson, S. J. Hunter, H. H. Severin, A. L. Melander, and R. C. Shannon.

In 1873 in the third volume of his Monograph, Loew included a key for the genera of North America. Later, Williston published one in his Manual of North American Diptera and still later Coquillett re-

vised Williston's key. Each of these, while superior to its predecessor, left much to be desired. In 1914 Hendel published a key to the genera of the world which gives a good working basis in the establishment of generic limits. It possesses advantages over the others but even here are found several weaknesses which prevents its use without some revision. The key which I present here is modified from that of Hendel so that it will fit the North American genera, at least so far as is possible with the eastern material at hand.

### KEY TO THE GENERA.

*A.* Wings not reticulate but banded or brown-spotted or hyaline. If they are brown with larger white spots and marginal indentations so that doubt may arise, then there are also six scutellar bristles or the dorso-centrals are placed posterior to the anterior supra-alars and at the same time, the $R_{4+5}$ vein is bristly.

*B.* Dorso-central bristles always placed behind the anterior supra-alars or wanting.

*C.* Scutellum with six or more marginal bristles. Front at least as broad as half the head. Cross-veins approximate. Wing markings consist of a few irregular brown spots. . . . **Xenochæta** Snow.

*CC.* Scutellum with two or four bristles.

*D.* Proboscis geniculate, as long as the head and thorax combined; anal cell closed by the convex vein $Cu_2$, thus being rounded out posteriorly; wing hyaline with incomplete cross-bands. . . . . **Aleomyia** new genus.

*DD.* Proboscis much shorter than the length of head.

*E.* Head inflated so that the vertex is rounded up between the eyes. Front twice as broad as one eye, and with a trough-like depression running lengthwise, the edges of which are provided with rod-like bristles in the male. **Straussia** R. D.

*EE.* Head not inflated and swollen at the vertex.

*F.* Vein $M_{1+2}$ more or less bent up at the extreme tip; cell $R_5$ narrowed at the margin; ovipositor long and conical. . . . . **Anastrepha** Schiner.

*FF.* Vein $M_{1+2}$ not bent up at the extreme tip.

*G.* Discal cell irregular in outline. Vein $M_{1+2}$ is bent inward before the *r-m* cross-vein, thus jutting down into the discal cell . . . . . **Epochra** Loew.

*GG.* Discal cell normal; not as in the preceding.

*H.* Third joint of antenna with a sharp, awl-shaped point in front. . . . . **Zonosema** Lw.

*HH*. Third joint of antenna rounded in front. Wing with crossbands, rather than true rivulets.
**Phorellia** R. D.

*BB*. Dorso-central bristles in or in front of a line connecting the anterior pair of supra-alars.

*C*. Scutellum with six bristles; the basal cells R and M short, anal cell shorter than M (Compare preceding *C*). . . **Xenochæta** Snow.

*CC*. Scutellum with two bristles or occasionally four, but if four, then the picture of the wing is entirely dark shining brown with hyaline marginal indentations both on the anterior and posterior margins and two or three conspicuous round spots on the disc of the wing.

*D*. Scutellum with a median furrow, bifurcate. Crossbands dark brown. . . . . **Peronyma** Loew.

*DD*. Scutellum not bifurcate. When there are more than two scutellar bristles, the wing pattern is as described in *CC*.
**Aciura** R. D.

*CCC*. Scutellum with four bristles and with a wing pattern not as described in *CC*.

*D*. Vein $R_{4+5}$ distinctly bristly from the base well along the vein.

*E*. Wing with four very oblique, yellow, brown-margined crossbands and with cross-veins approximate, oblique and nearly parallel. . . . . **Tomoplagia** Coq.

*EE*. Wing with dark brown markings differing from above. Small cross-vein perpendicular, but the posterior cross-vein oblique. Cross-veins approximate. The crossband over the *r-m* cross-vein is connected in the discal cell with the brown of the wing base. . . . . **Acidia** R. D.

*DD*. Vein $R_{4+5}$ bare or nearly so.

*E*. Anal cell distally margined by a straight or convex $Cu_2$ so that $R_5$ is no drawn-out point. Cell $R_5$ not narrowed in the margin. Face produced snout-like with a median carina. Wing with four complete crossbands. Proboscis geniculate, as long as head. . . . . **Gonioglossum** Rond.

*EE*. Anal cell distally closed by the concave $Cu_2$ and drawn out into a point.

*F*. *R-m* cross-vein placed in the middle of the discal cell.

*G*. Scutellum swollen. Two pairs of very stout bristles on costa, one at humeral cross-vein and the other at the end of the subcostal vein. Subcosta suddenly bent up at right angles, before the apex, making the stigma very short. Third antennal joint rounded in front. . . . . **Stenopa** Loew.

*GG*. Scutellum not swollen. Third antennal joint usually

with a sharp point in front. Front as broad as one eye but longer than it is broad. .... **Rhagoletis** Loew.

*FF*. Cross-veins approximate, the *r-m* cross-vein placed distad of the middle of the discal cell.

*G*. Scutellum strongly arched, inflated and highly polished. Fly usually with a shiny black ground color but sometimes a shiny yellowish-brown.

**Procecidochares** Hend.

*GG*. Scutellum flattened above, not inflated, somewhat pointed posteriorly and but little shining.

*H*. Discal cell distinctly longer than the last segment of vein $M_{1+2}$. Picture of wing touching or covering the apex of this vein. .... **Terellia** R. D.

*HH*. Discal cell as long as the last segment of vein $M_{1+2}$. Picture of wing, if present, not touching the apex of this vein. .... **Neaspilota** O. S.

*AA*. Wing reticulate, or at least with reticular crossbands. The anterior dorso-central pair of bristles is always anterior to the first supra-alars, near to the transverse suture. Vein $R_{4+5}$ either bare or bristly.

*B*. Wing very broad, more than half as wide as long; strongly convex margin.

*C*. Wing with proximal half, brown, reticulate and distal half with yellow rivulets or crossbands. ..... **Acrotænia** Lw.

*CC*. Wing reticulate throughout.

*D*. Wing dark brown with numerous but minute yellow dots and with the apex tipped by a narrow white crescent.

**Eutreta** Loew.

*DD*. Wing brown with numerous but conspicuous hyaline spots, almost equal amounts of the area dark and hyaline. Many rather small marginal spots. ..... **Xanthomyia** new genus.

*BB*. Wing of normal shape or else very long and narrow.

*C*. Face and cheeks and usually the front with black spots and flecks. Wing rayed at the margin and with eye-spots on the disc.

**Paracantha** Loew.

*CC*. Face and cheeks without black spots and flecks, at most a dark spot between the antenna and eye.

*D*. Front much broader than half the head, three or four times as broad as one eye.

*E*. Third antennal joint elongate with a sharp edge in front. Face retreating. ..... **Acidogona** Loew.

*EE*. Antennæ short, scarcely half as long as face, third joint rounded in front. Antennæ somewhat separate at base.

**Eurosta** Loew.

*DD*. Front narrower, at most twice as broad as one eye.

*E*. General color of body and wings is yellow, the latter being

a torn network of dark brown with yellow droplets. Apex and hind margin of wing is brown with only white spots. Often there is a black spot between the antenna and eye.
**Icterica** Lw.

*EE.* Wing with a brown to blackish network upon a hyaline or white ground or vice versa.

*F.* Apex of cell $R_5$ broadly and deeply hyaline, at most with a narrow brown border to the veins.

*G.* The dark reticulation extending over two thirds of the wing. Scutellum with four bristles. Abdomen comparatively heavy and robust, generally wider than the thorax and, as a rule, shorter, although sometimes in the female, the abdomen nearly equals it in length. ..... **Euaresta** Loew.

*GG.* The dark reticulation covering only a small portion of the area, not more than a third, and never extending into the costal cell. Scutellum has either two or four bristles, and the abdomen is more elongate, generally narrower and longer than the thorax.
**Trypanea** Schrank.

*FF.* Apex of cell $R_5$ not broadly and deeply hyaline, hence no stellate reticulation on the tip of the wing.

*G.* Proboscis greatly elongate, labellæ geniculate and equalling the head in length. Cheeks and genæ very narrow. Two or three lower fronto-orbitals. Mouth margin strongly projecting. Front averages longer than broad. ..... **Ensina** R. D.

*GG.* Proboscis of normal length, labellæ short or if somewhat elongate and geniculate, it is then shorter than the head. Vein $R_{4+5}$ bare or indistinctly bristly.
**Euribia** Hend.

Genus **XENOCHÆTA** Snow. 1894.

Genotype, *Xenochæta dichromata* Snow.

Genus **ALEOMYIA** new genus.

Genotype, *Aleomyia alpha* new species.

This genus is quite distinct from others by reason of its elongate geniculated proboscis which if straightened out would measure at least the length of the head and thorax combined. The anterior pair of dorso-central bristles are placed far behind the line connecting the anterior supra-alars. The wing venation is likewise characteristic, the *r-m* cross-vein being placed before the middle of the discal cell and the anal cell being closed posteriorly by the convex $Cu_2$. The wing

pattern is made up of more or less isolated spots, or interrupted cross-bands. Its nearest relative is found in the genus Gonioglossum Rond., but the characters described above and particularly the length of the proboscis and the position of the dorso-central bristles will readily distinguish it.

**Aleomyia alpha** new species. Fig 1.

Clay-yellow with the tip of the ovipositor black, and in the male with the lateral edges of the abdomen of a dark brown color. Dorsum of thorax and front both with a glistening golden pollen and the whole body, with the exception of the head, everywhere covered with fine black hairs. Face projecting, snout-like; proboscis greatly elongated and geniculated. Antennæ short and covered with a shining silvery pollen. Front twice as broad as one eye, trough-like with the lateral edges raised. These ridges bear two pairs of stout black lower fronto-orbitals as well as a row of fine black hairs margining the eye. The scutellum is unicolorous, honey-yellow and bears four black bristles. Abdomen is densely clothed with black hairs. Ovipositor golden brown at base and black at the tip, the whole being at least four fifths as long as the abdomen; the proximal half is conical but there becomes suddenly constricted, leaving the distal section only half as wide as the proximal and hardly tapering towards the rather blunt end. The hyaline wings are of normal size and shape with several light-brown spots which tend to form more or less distinct bands, particularly in the male. One narrow, pale band crosses the wing in the vicinity of the humeral cross-vein; another elongated spot at distal end of cell M and anal cell; a third extends from the yellow stigma across the *r-m* cross-vein and the discal cell and for a short distance into cell $Cu_1$, being darkest in cell $R_1$ and at the point where it crosses the *r-m* cross-vein, and almost interrupted in cell $R_3$ and discal cells; another small spot bisects cell $R_1$, extending from the anterior margin to vein $R_{2+3}$; a fifth elongated spot extends across the wing in the region of the *m* cross-vein which it completely covers; in the male, this spot or line is widely interrupted in cell $R_5$ but continues from before the vein $R_{4+5}$, through cell $R_3$, over vein $R_{2+3}$ and through cell $R_1$ to touch the anterior margin slightly before the tip of vein $R_{2+3}$. In the male this fifth band is more or less continuous from the anterior to the posterior margin of the wing. The sixth spot covers the apex of the wing, extending across the tip of cell $R_5$ and slightly into cell $R_3$ on one side and into cell $2dM_2$ on the other. Vein $R_{4+5}$ is not bristly, the *r-m* cross-vein is before the middle of the discal cell and both cross-veins are perpendicular. The vein $Cu_2$ is convex. Female 5.5 mm., male 4.5 mm. Described from three males and six females taken on sunflower at Plummer's Island, Maryland, by R. C. Shannon on the 5th of August, 1913, and the 29th of August, 1915; by J. C. Crawford on the 14th of August, 1916.

## Genus **STRAUSSIA** R. D. 1830.

Genotype, *Straussia longipennis* Wied.

The members of this genus are distinctly yellow with long bodies and rather remarkably shaped heads. The whole head is swollen, especially the occiput. The lateral borders of the front are raised so that the whole front assumes the appearance of a basin. The eyes are rounded and small. The scutellum is convex, clear yellow and bears four stout and long yellow bristles. The wings are comparatively long and hyaline with a yellow or brown rivulet pattern. The veins $R_1$ and $R_{4+5}$ are distinctly bristly, while the *r-m* cross-vein is placed beyond the middle of the discal cell and the posterior angle of the anal cell is drawn out into a sharp point.

**Straussia longipennis** Wied.

The single species in the genus is quite variable. Loew has separated it into seven varieties and I am including a key compiled from his descriptions and the specimens before me. It is not a difficult problem to pick out individual specimens that perfectly fit his varieties, but it is quite impossible to place every specimen in one of his groups. There are so many intergradations that one can practically follow every variation of the wing pattern from one variety to another, while the extremes in the different directions seem to show distinct varieties.

I have quite a series of specimens, reared by the Cornell University Experiment Station from larvæ infesting the canes of sunflower. Their wing patterns indicate that they are intermediate between *var. typica* and *var. longitudinalis*. They differ from both these varieties, however, in the fact that the upper fronto-orbital bristles in the male are not incrassated and truncate. The upper fronto-orbital bristles of some, reared in the same lot, closely resemble those of *var. typica*.

Mr. H. H. Knight reared *S. longipennis* from larvæ in canes of Jerusalem Artichoke, the tubers of which were imported from Europe. These specimens were taken at Attica, N. Y.

### KEY TO THE VARIETIES.

*A*. Of the four fronto-orbital bristles, the two upper ones are very much incrassated and truncate at the end in the male.

*B*. Thoracic dorsum shows, besides the anterior end of the middle stripe,

two well-marked black lateral stripes, interrupted at the transverse suture and pointed posteriorly. The wings of both male and female are very like var. *perfecta*. ..... **vittigera** Lw.

*BB*. Thoracic dorsum without lateral stripes.

*C*. Scutellum unicolorous. The picture of the wings is not deep in coloring. ..... **perfecta** Lw.

*CC*. Scutellum with dark corners.

*D*. Wing of male narrower than in all other varieties. Picture coalesces into a single broad longitudinal stripe, which is of a dirty clay-yellow color at the base and brown beyond. A spot in the costal cell is very dark in both sexes, the wing of the female otherwise being like var. *typica*. The band covering the *m* cross-vein extends to the margin. **longitudinalis** Lw.

*DD*. Wing picture is complete in female but not in the male. The band covering the *m* cross-vein does not reach the margin. In both sexes, the band over the vein $M_{1+2}$ to the margin is broader. ..... **typica** Lw.

*AA*. The upper fronto-orbitals in the male end as usual in a point. They are not incrassated and not truncate at the tip.

*B*. The thoracic dorsum is without black lateral stripes. The scutellum has black corners and the metathorax has a black, elongated spot on either side. The last joint of all the feet is rather conspicuously infuscated on the sides and end. ..... **intermedia** Lw.

*BB*. The thoracic dorsum has black lateral stripes.

*C*. The picture is not interrupted on the anterior margin beyond the triangular hyaline spot near the stigma. The dark band, covering the *m* cross-vein, is interrupted, thus the hyaline band between the cross-veins is connected with the clear part of the cell $R_5$. **arculata** Lw.

*CC*. The oblique hyaline band between the cross-veins reaches the anterior margin as usual. The branch of the rivulet margining the apex of the wing and that which runs along the last section of the vein $M_{1+2}$ coalesce in their middle. ..... **confluens** Lw.

**Straussia longipennis** var. **perfecta** Lw. Fig. 2.

Besides the specimens which I have from Pennsylvania, New York and Colorado, this variety has also been recorded from Kansas and Connecticut.

**Straussia longipennis** var. **typica** Lw. Fig. 3.

I have numerous specimens from Pennsylvania, New York, Connecticut, Maryland, North Carolina, Illinois, Quebec, Montana, and records from Kansas and California.

**Straussia longipennis** var. **longitudinalis** Lw. Fig. 4.

My material was taken in New York, Pennsylvania and North Carolina, but it is also reported from Connecticut and Colorado.

**Straussia longipennis** var. **vittigera** Lw. Fig. 5.

I have specimens from Illinois and Montana with records from Nebraska, Kansas and California.

**Straussia longipennis** var. **intermedia** Lw. Fig. 6.

I have only a single specimen from Ithaca, N. Y.

**Straussia longipennis** var. **confluens** Lw.

Loew records this variety from Connecticut.

**Straussia longipennis** var. **arculata** Lw. Fig. 7.

My specimens are from Montana and Colorado while it is reported from Illinois.

Genus **ANASTREPHA** Schiner. 1868.

Genotype, *Anastrepha serpentina* Wied.

Genus **ZONOSEMA** Lw. 1873.

(= *Spilographa* Loew 1873.)

Genotype, *Zonosema meigeni* Lw.

The representatives of this genus are yellow with hyaline wings that are banded with brown. The scutellum has four black bristles. They are close relatives of the genus *Phorellia,* but differ in the shape of the antennæ, the third joint of which has a sharp awl-shaped point on the front in *Zonosema.* In our eastern species, there is also a small, comma-like crossband between the two larger bands which cover the cross-veins. This small band extends from the anterior margin, through cell $R_1$ and across vein $R_{2+3}$ into cell $R_2$. The anterior pair of dorso-central bristles is noticeably behind the anterior pair of supra-alars, whereas in *Phorellia,* they are practically in a line with them.

KEY TO THE SPECIES.

*A.* The *r-m* cross-vein is placed in the middle of the discal cell; and is perpendicular. There are four lower fronto-orbitals. The yellow scutellum has a black spot on either lateral corner and the yellowish-brown thorax has bright yellow stripes on the dorsal and lateral surfaces. The last segment of the abdomen bears a black spot on each side. Vein

$R_{4+5}$ is bristly from the base distally to the region above the *m* cross-vein. ..... **electa** Lw.

*AA*. The *r-m* cross-vein is placed before the middle of the discal cell. There are three lower fronto-orbitals and the scutellum is unicolorous.

*B*. Vein $R_{4+5}$ is distinctly bristly. The anterior pair of dorso-central bristles is comparatively nearer the cephalic end than in *setosa;* if a line connecting the anterior pair of dorso-centrals were extended at the sides between the two supra-alars nearest the dorso-centrals, this line would more nearly approach the anterior pair than the posterior. The crossband which covers the *r-m* cross-vein is very indistinct, almost interrupted, in the discal cell. **flavonotata** Macq.

*BB*. Vein $R_{4+5}$ is not bristly, at most with only a couple at the extreme base and one further distad in the vicinity of the *r-m* cross-vein. The line connecting the anterior pair of dorso-centrals, if extended laterally, would pass midway between the anterior supra-alar and the one directly caudad. There is no interruption of the crossband in the discal cell. ..... **setosa** Doane.

**Zonosema electa** Say. Fig. 8.

My specimens are from North Carolina and Maryland, but it is also reported from Florida, Georgia, Tennessee, Kansas, Indiana, Connecticut. The larvæ live in the berries of *Solanum carolinense*. The wing of a variant from Texas is shown in figure 66.

**Zonosema flavonotata** Macq. Fig. 9.

= *Zonosema basiolum* O. S.

I have specimens from New York and Massachusetts and a record from Maryland.

**Zonosema setosa** Doane. Fig. 10.

I have only a single specimen from Washington but records from Idaho, South Dakota, Michigan and Minnesota.

### Genus **ACIDIA** R. D. 1830.

The general color is yellow or light brown and our eastern species, at least, have minute black or dark brown punctures in various places on the body. They are seen on the front and vertex, upon the dorsum of the thorax and abdomen and upon the scutellum. They are often wanting in some of these regions but never in all at one time. The third antennal joint is rounded in front. The anterior pair of dorso-centrals is about in a line with the anterior supra-alars. The yellow scutellum has four black bristles. The wings are hyaline with light brown rivulets, vein $R_{4+5}$ being bristly.

KEY TO THE SPECIES.

*A.* The cross-veins are approximate. The punctures on the body are black, and the wing has a rather complicated rivulet pattern as in the figure. **fratria** Lw.

*AA.* The *r-m* cross-vein is placed in the middle of the discal cell. The punctures are brown and the wing has a dark-brown S-shaped rivulet. **sigma** new species.

**Acidia fratria** Lw. Fig. 11.

My specimens are from District of Columbia, New York and California and it is reported from Washington, New Hampshire, New Jersey and Missouri. The larvæ mine in the leaves of parsnip.

**Acidia sigma** new species. Fig. 12.

Clay-yellow with numerous dark brown spots on the head, dorsum of thorax and abdomen and on the scutellum. The bristles of the head are stout and black while the antennæ are yellow with the arista darker at the tip. The dorsum of the thorax is shining yellowish-brown with many small black hairs. The anterior dorso-central bristles are in a line with the anterior supra-alars and the scutellum has four black bristles. The abdomen is densely covered with black punctures with a black hair in each, while the ovipositor is golden brown, conical, about as long as the last two segments taken together. The legs are yellow and the wings hyaline with a brown rivulet pattern. Vein $R_{4+5}$ is bristly as far as the *r-m* cross-vein. The cross-veins are approximate, the *r-m* perpendicular, the *m* cross-vein oblique. Base of the wing is somewhat yellowish and the brown rivulet forms a complete S on the distal half. One end of the S fills the stigma and crosses the *r-m* cross-vein to the posterior margin, there turning back to cover the *m* cross-vein and reaching the anterior margin slightly beyond the middle of cell $R_1$ and from there following around the tip of the wing as an apical band as far as the tip of cell $2dM_2$.

Two female specimens, collected by R. C. Shannon, Plummer's Island, Maryland, June 20, 1916. Length 5.5 mm. The holotype is placed in the collection of the United States National Museum, the paratype in that of Cornell University.

Genus **GONIOGLOSSUM** Rond.

Genotype, *Gonioglossum wiedemanni* Meig.

Genus **PHORELLIA** R. D. 1830.

(= *Spilographa* Lw.)

Genotype, *Phorellia artemisiæ* Fabr.

This genus differs from *Zonosema* in having no sharp awl-shaped point on the front of the third joint of the antenna, although this joint may be more or less tapering towards its end. There is no small cross-

band between the bands that cover the cross-veins. The anterior pair of dorso-central bristles is in a line with the anterior supra-alars.

**Phorellia tortilis** Coq. Fig. 13.

This is a pale-yellowish species which has three lower orbitals. The small cross-vein is in the middle of the discal cell and vein $R_{4+5}$ is very sparingly bristly.

A single specimen loaned me by C. W. Johnson was taken at Bretton Woods, N. H., but it is also reported from Washington.

Genus **PERONYMA** Lw. 1873.

Genotype, *Peronyma sarcinata* Lw.

**Peronyma sarcinata** Lw. Fig. 14.

The species differs very materially from any others in this region. The flies are reddish-brown and always dark in general color. The scutellum is unique, being shining black, swollen and bifurcate. Each division thus made bears a single stout black bristle and, contrary to Mr. Loew's opinion, I can discover no trace of the existence of another smaller pair. The wings are rather long and heavy, being hyaline with broad, dark-brown oblique bands, the second of which covers both cross-veins. The cross-veins are oblique and approximate. The discal cell is peculiarly shaped, wide and rounded distally and considerably tapered at the proximal end.

One specimen from Alabama was loaned by R. C. Shannon and it is also reported from South Carolina. I thought it well to include this species in my study as the genus is so distinct and because its range is close to our limits.

Genus **ACIURA** R. D. 1830.

There seems to be even more confusion in this than in other genera of this family. Hendel adopts three genera of this group, *Aciura, Xanthaciura* and *Tetraciura*. Our eastern species that have four scutellar bristles and an anal cell that is drawn out posteriorly will fit into none of these. Our species seem to possess some of the characteristics of each of Hendel's genera and therefore it would be much simpler and bring the species together in truer relationship if we used the one old genus *Aciura*. The others would then fall into line as subgenera and the puzzle of where to place our species be solved by the erection of a new subgenus.

The chief characteristic of the genus *Aciura* would then be its peculiar wing pattern. It is shining black without any clear or yellow punctures. There are, however, upon both the anterior and posterior sides, triangular marginal indentations and one to three clear round spots on the disc.

*Trypeta nigriventris* Macq. was described from material recorded from Baltimore. It doubtless belongs to the genus *Aciura*.

KEY TO THE SUBGENERA.

*A*. Two bristles on the scutellum.
  *B*. Postocular cilia black or dark. ..... **Aciura** Hend.
  *BB*. Postocular cilia yellow. ..... **Xanthaciura** Hend.
*AA*. Four bristles on the scutellum.
  *B*. Anal cell distally margined by a straight or convex $Cu_2$ so that there is no drawn-out point. ..... **Tetraciura** Hend.
  *BB*. Anal cell margined by a concave $Cu_2$ so that the cell is drawn out into a distinct point. ..... **Eucosmoptera** new subgenus.

KEY TO THE SPECIES OF THE SUBGENUS EUCOSMOPTERA.

*A*. Vein $R_{4+5}$ bristly. Front broad, with the lateral borders raised, which in the male bear three large black spines and two bristles. The postocular bristles are black. The body is wholly reddish-yellow with the exception of the abdomen. This is entirely shining black in the male, while the extreme tip and the ovipositor are black in the female. The wings are broad, the *m* cross-vein perpendicular. ..... **nigricornis** Doane.
*AA*. Vein $R_{4+5}$ not bristly.
  *B*. The *m* cross-vein is very oblique and the wing broad. The disc has a single hyaline spot which is situated in the discal cell and crosses vein $Cu_1$ so that it slightly enters cell $Cu_1$. The body is reddish-yellow and polished. ..... **limata** Coq.
  *BB*. The *m* cross-vein is perpendicular, and the wing comparatively long and narrow, with three spots on the disc. The thorax and the tip of the abdomen are black, the rest of the body being reddish-yellow, while the whole is shining where not covered with grey pollen. **tetraspina** new species.

**Aciura** (*Eucosmoptera*) **nigricornis** Doane. Fig. 15.

In the original description Mr. Doane mentions that there are only two strong bristles on the scutellum. He further states that the abdomen is missing. I have two specimens, a male and a female, both from New York, each of which has four prominent scutellar bristles. Mr. R. C. Shannon examined the material in the United States National Museum, three specimens from Massachusetts and New Hamp-

shire, and reports four scutellar bristles on these specimens. These facts lead me to believe that one pair of the bristles had been broken from the type specimen along with its abdomen. It is reported from Pennsylvania and Vermont.

**Aciura** (*Eucosmoptera*) **limata** Coq. Fig. 17.

The wing figure of this species was drawn by Mr. M. E. Phillips from the specimen in the U. S. National Museum. It has been reported only from Massachusetts.

**Aciura** (*Eucosmoptera*) **tetraspina** new species. Fig. 16.

Front golden yellow, only two thirds as wide as one eye. Bristles of head dark brown or black, occipital row quite heavy and white and another row of much smaller white pile margining the eye on the front. Antennæ honey-yellow, arista brown. Face pale yellow, somewhat retreating. Thorax grey-pollinose, densely covered with white stubble-shaped pile and long yellow bristles. Scutellum also grey-pollinose with four yellow bristles, the pair near the lateral corners being very long, at least three times as long as the central pair. The proximal half of the abdomen and the feet are shining brownish-yellow, and with the shining black distal half of the abdomen are covered with yellowish-brown hairs. The wing closely resembles that of *T. insecta* Lw., figured by van der Wulp. The pattern shows a shining longitudinal black band running the length of the wing with two hyaline indentations through the costal cell, and two larger ones in cell $R_1$ beyond the stigma. Cell $2dM_2$, likewise, has two deep hyaline indentations and proximad of this, the edge of the dark band follows approximately vein $Cu_1$. The edge is wavy with four points of dark jutting down into the hyaline. The disc of the wing bears three round hyaline spots, two in cell $R_5$, one before and one after the *m* cross-vein, and the third in cell R. Vein $R_{4+5}$ is bare. Male 2.5 mm., female 3.5 mm.

Described from two males and three females collected by C. R. Crosby in Columbia, Mo., 26 May–8 June, 1906.

Genus **TOMOPLAGIA** Coq. 1910.

(= *Plagiotoma* Lw. 1873.)

Genotype, *Tomoplagia obliqua* Say.

The chief characteristics of this genus are found in its four-bristled scutellum and in the peculiarities of the wing. The latter are rather large with a distinctly convex anterior margin. The cross-veins are oblique and approximate. Vein $M_{1+2}$ is bowed up beyond the *m* cross-vein. Vein $R_{4+5}$ is very conspicuously bristly from the base well beyond the *m* cross-vein. The picture of the wing consists of four very oblique cross bands, the second of which covers both cross-veins.

**Tomoplagia obliqua** Say. Fig. 18.

Specimens from California and Arizona, but it is recorded from Pennsylvania, Indiana, Illinois, Iowa, New Jersey, Texas and Kansas. The adults were taken on *Vernonia* in August by Osten Sacken.

### Genus **EPOCHRA** Lw. 1873.

Genotype, *Epochra canadensis* Lw.

This genus has much in common with *Acidia* and, like it, has the dorso-central bristles placed behind the anterior supra-alars. The flies have the same general color, yellow or pale brown, but lack the dark punctures. The yellow scutellum has four bristles. The hyaline wing could scarcely be considered as rivuleted, although it is indicative of that pattern. Vein $R_{4+5}$ is bristly and vein $M_{1+2}$ has a peculiar bend before the *r-m* cross-vein which causes it to project down into the discal cell. The dark band which covers the *m* cross-vein is not connected with the brown of the wing base.

**Epochra canadensis** Lw. Fig. 23.

My specimens are from Lorenzo, Cal., and Orono, Maine, but it has also been taken in Canada, Washington, Colorado and British Columbia. The larvæ feed in berries of currants and gooseberries.

### Genus **STENOPA** Lw. 1873.

Genotype, *Stenopa vulnerata* Lw.

**Stenopa vulnerata** Lw. Fig. 20.

This is a black fly covered with grey almost stubble-shaped pile. The shining black scutellum is swollen and bears four black bristles. The wing is hyaline, large and broad with black rivulets. Vein $R_{4+5}$ is bare and is bent down toward its apex so that the margin of cell $R_5$ is narrowed. The stigma is likewise peculiar, being as deep as long, on account of a sudden turning up of vein $R_1$. The presence of two pairs of heavy costal spines seems to be unique. These are situated, one at the humeral cross-vein and the other at the end of the subcostal vein.

The specimens are from Nance, North Carolina, but it is reported from Massachusetts, Connecticut and Tennessee.

Genus **RHAGOLETIS** Lw. 1862.

Genotype, *Rhagoletis cerasi* Linn.

Most of the species in this genus have black bodies and hyaline, black-banded wings. *R. suavis* Lw. is an exception, however, and has a yellow head, thorax and feet, but with a dark-brown abdomen. The wings are of the same general plan, hyaline with dark-brown bands or rivulets. The front is as broad as one eye, but longer than broad in all species. The third joint of the antenna usually has a point in front. The four-bristled scutellum is either whitish yellow or has a conspicuous yellow spot. Vein $R_{4+5}$ of the wing is bare, or with two or three minute bristles at the base. The *r-m* cross-vein is in the middle of the discal cell.

KEY TO THE SPECIES.

*A*. Wings with a hyaline band extending completely across between the two cross-veins.

*B*. A clear hyaline band extending across the wing from the costal cell over the distal end of basal cell M.

*C*. The last two of the four bands is connected in the shape of an inverted V, the last margining the apex of the wing to beyond the tip of $M_{1+2}$, except for the presence of a minute hyaline crescent on the extreme edge for a part of the distance. The picture of the thoracic dorsum differs from *R. tabellaria*. It is mostly covered with grey pollen, so that the intervening shining black stripes are very narrow. The scutellum differs from *R. cingulata*. In the present species it is shining black with only a clear white spot on dorsum. ..... **juniperinus** Marc.

*CC*. The apex of the wing has a black spot which is generally separated from the last crossband although sometimes it is connected between the veins $R_{2+3}$ and $R_{4+5}$. The scutellum is almost wholly yellow, the black appearing only as dark lateral corners. **cingulata** Lw.

*BB*. The first two bands of the wing are connected on the posterior margin, the last two on the anterior margin, thus giving the wing the appearance of having a V and an inverted V. The picture of the thoracic dorsum is composed of four rather narrow stripes covered with grey pollen. All four stripes are short, the two central ones being only half the length of the thorax and the lateral, which are widely interrupted at the suture, even shorter. The intervening black spaces are about the same width as the stripes. **tabellaria** Fitch.

*AA*. Wings without a clear hyaline band extending from the anterior to the posterior margin, between the cross-veins.

*B.* A separate branch, coming off from the main rivulet pattern, covers the *m* cross-vein.

*C.* The wing is without an apical hyaline crescent. There is a deep marginal triangle beyond the stigma which extends below vein $R_{4+5}$, and a clear, hyaline band running across the wing from the costal cell over the apex of basal cell M. The body is yellow with a brown abdomen. ..... **suavis** Lw.

*CC.* The wing has an apical hyaline crescent. Instead of a hyaline triangle beyond the stigma, there is one beginning in the costal cell, whose apex extends down into the base of cell $Cu_1$ **pomonella** Walsh.

*BB.* A separate branch comes off from the main rivulet pattern in the posterior apical region but does not cover the *m* cross-vein.

*C.* There is a conspicuous round "shot-hole" in the black of the discal cell. A hyaline triangle beyond the stigma extends down into cell $R_5$, and the two hyaline indentations on the posterior margin of the apical end extend well up into the wing. The proximal indentation crosses vein $M_{1+2}$ and juts up into cell $R_5$, and the distal one margins the wing below vein $M_{1+2}$ and goes back across cell $R_5$ into cell $R_3$. ..... **fausta** O. S.

*CC.* The wing is without a "shot-hole" in the black of the discal cell. The hyaline triangle beyond the stigma is produced toward the posterior margin between the cross-veins and well into cell $Cu_1$. The proximal indentation on the posterior margin occupies about half of cell $2dM_2$ without crossing vein $M_{1+2}$. The distal indentation margins the wing below vein $M_{1+2}$ and curves up into cell $R_5$ and touches, but does not cross, vein $R_{4+5}$. **striatella** v. d. W.

**Rhagoletis juniperinus** Marc. Fig. 19.

My specimens are from Six Mile Creek, Ithaca, New York, where Mr. Marcovitch found the larvæ living in the berries of *Juniperinus virginianus.*

**Rhagoletis cingulata** Lw. Fig. 22.

Although my specimens are all taken in New York, this species is also reported from the Middle States, New Jersey and Massachusetts. The larvæ live in cherries and do considerable damage in some localities.

**Rhagoletis tabellaria** Fitch. Fig. 21.

The specimens are from Hamburg, New York, Washington and Nebraska and it has been taken in Canada. The Washington specimen was taken on Western Tall Blueberry.

**Rhagoletis suavis** Lw. Fig. 24.

I have material from Plummer's Id., Maryland, and from New York. In some regions this species does much damage to Black Walnuts, the larvæ living in the outer husks of the fruits.

**Rhagoletis pomonella** Walsh. Fig. 25.

This species is rather widely distributed over the northeastern states, occurring in South Dakota, North Dakota, Michigan, Illinois, New Jersey, New York, Massachusetts, Maine and Nova Scotia. The young live in fruit of apple, Cratægus, blueberry and cranberry.

**Rhagoletis fausta** O. S. Fig. 26.

My specimens are taken in New York but it is reported from New Hampshire and British Columbia where the larvæ do considerable damage to cherries.

**Rhagoletis striatella** v. d. W. Fig. 27.

Mr. C. W. Johnson writes me that he has one specimen from Illinois but the species was described from Mexican material.

## Genus **PROCECIDOCHARES** Hendel. 1914.

(= *Œdaspis* Lw.)

Genotype, *Procecidochares atra* Lw.

Most of the species of this genus are shining black, although *P. penelope* O. S. is of a shining yellow and brown color instead, and pretty generally covered with white or yellowish stubble-shaped pile. The scutellum is always black, shining, greatly swollen, and bears four bristles. The wings are hyaline with heavy brown or black crossbands or rivulets. The cross-veins are greatly approximated and vein $R_{4+5}$ is bare.

### KEY TO THE SPECIES.

*A.* The lower fronto-orbital bristles are set well back from the eye, almost the width of the third antennal joint from its margin. The front is broad, generally over twice the width of one eye and is very pale yellow or white. The front, face, genæ, and cephalic region are densely covered with white stubble-shaped pile. The femora are yellow or very pale brown. ..... **polita** Lw.

*AA.* The lower fronto-orbitals are very close to the eye. The front is conspicuously narrower.

*B.* The basal black spot of the wing does not extend proximad of the

humeral cross-vein. The third crossband is definitely connected on the anterior margin with those forming an inverted V with its apex in the stigma. A shadowy, triangular spot in the hyaline of cell $Cu_1$ is quite characteristic. The cross-veins are neither curved nor parallel. ..... **penelope** O. S.

*BB*. The basal spot covers the humeral cross-vein and extends as far proximad as distad of it. The third black band is not connected with the inverted V.

*C*. The cross-veins are straight and parallel. The femora are black and the rest of the feet and legs yellow. There are three pairs of dorso-centrals, the anterior placed before the suture but not laterally situated as are the presuturals. The wing pattern resembles that of *P. atra*..... **setigera** Coq.

*CC*. One or both of the cross-veins are curved and they are not parallel. Two pairs of dorso-centrals..... **atra** Lw.

I can find no constant character by which to separate *P. atra* and *P. anthracina*. My eleven specimens vary so much in structural characters that I hesitate to use color separations. The legs of *P. atra* have dark brown or black femora with the rest of the legs and feet yellow, except a darker spot on the tip of the tarsus. *P. anthracina* seems to have lighter legs and no dark tarsal tip. The two wings of one specimen vary as regards exact position and direction of many veins. The bristles on the head and thorax are not constant, the lower fronto-orbitals varying from two to four pairs. The lower pair of the superior fronto-orbitals is not infrequently replaced by a cluster of two or three and the scutellum itself, in one instance, bears six bristles. Several of my specimens of *Procecidochares* possess the supernumerary cross-vein which Loew mentions in his description of *T. gibba,* and I feel certain that the whole group is irregular and that his *T. gibba* is a freak of *P. polita* Lw.

**Procecidochares polita** Lw. Fig. 28.

I have several specimens from Pennsylvania, Kansas and Georgia. It has, however, a rather wide eastern distribution, being reported from Mississippi, New York, Connecticut, New Jersey and from the District of Columbia. This species forms the Leafy Rosette Gall of the Goldenrod (*Solidago altissima*).

**Procecidochares penelope** O. S. Fig. 29.

The single specimen was taken at Manlius, New York.

**Procecidochares setigera** Coq. Fig. 30.

My one specimen, loaned by the U. S. Nat. Mus., was without a locality label. It is recorded from Rhode Island, Virginia, Georgia, Missouri and Kansas.

**Procecidochares atra** Lw. Fig. 31.

= *Procecidochares anthracina* Doane.

This species was taken in New York, Georgia and Nova Scotia.

Genus **TERELLIA** R. D. 1830.

(= *Trypeta* Lw.)

Genotype, *Terellia serratulæ* Linn.

These flies have very peculiarly shaped heads, which are more or less globular, puffed and rounded out in all directions. The lower fronto-orbitals are black and strong, the third pair from the antenna always being long enough to cross in the centre of the front, and this seems to be the characteristic position. They are quite heavy bodied flies, the head being wider than the thorax. The flattened scutellum bears four bristles. The wing is hyaline with a yellowish or grayish pattern of bands which are sometimes interrupted. The cross-veins are approximate and vein $R_{4+5}$ is bare. The picture touches or covers the tip of vein $M_{1+2}$.

KEY TO THE SPECIES.

*A.* Picture of the wings with a band margining the apex and covering the apices of veins $R_{2+3}$, $R_{4+5}$, and $M_{1+2}$. The yellow scutellum has dark lateral spots. A dark band extends from the anal cell region along vein $Cu_1$ to or almost to the *m* cross-vein. . . . . **palposa** Lw.

*AA.* No apical band as described above.

*B.* The wing is clear from base as far distad as the stigma. A yellow species with yellow or pale brown bristles. The picture on the wing is pale or scattered, almost reticular. The wing is more or less milky and the abdominal segments are unicolorous. . . **vernoniæ** Lw.

*BB.* Basal region of the wing not clear as far as the stigma. This is a yellowish-gray species, much darker than the preceding, with a black ground color, covered with a yellowish-white pollen. The abdomen has four rows of black spots. Wings bear four dark-grey spots surrounded by clear hyaline spaces and with shadowy markings variously distributed. . . . . **florescentiæ** Linn.

**Terellia palposa** Lw. Fig. 32.

My specimens are from Ohio but it is recorded from Wisconsin, Minnesota, Iowa, Massachusetts and Kansas. Mr. Johnson reports,

"Common on thistle, *Cnicus pumilus,* at Hyannis Port, Mass., July 4, 1904."

**Terellia vernoniæ** Lw. Fig. 33.

I have a single specimen from North Carolina. It has been recorded from Pennsylvania and New Jersey, the adult being taken on *Vernonia.*

**Terellia florescentiæ** Linn. Fig. 34.
= *Terellia ruficauda* Lw.

The many specimens in this collection were collected in Nova Scotia and New York. It is reported from Canada, Maine and Massachusetts. Several adults emerged in captivity in November from infested thistle heads.

Genus **NEASPILOTA** O. S. 1878.
(= *Aspilota* Lw.)

Genotype, *Neaspilota alba* Lw.

The species of this genus are small flies whose bodies are covered with fine white or yellow pile. The head is generally about the same width as the thorax. The bristles of the head are weak, particularly the lower fronto-orbitals, the third pair from the antennæ never long enough to cross in the centre of the front. The thoracic dorsum usually has a dark pattern covered by the pollen and the yellow scutellum bears four bristles. The wings are without pattern or nearly so and are milky white. The cross-veins are approximate and vein $R_{4+5}$ is bare.

KEY TO THE SPECIES.

*A.* Wings are entirely clear, including the stigma. The body is a very pale yellow and covered with white pile. The veins of the wing are not dark colored. ..... **alba** Lw.

*AA.* The wings are not entirely clear, the stigma at least being colored.

*B.* The stigma only is brown while the rest of the wing is clear. The body is grey, covered with white pile. The veins of the wing are colored brown. ..... **albidipennis** Lw.

*BB.* The wing has a black spot through the stigma and also various dark spots on the apical half. These are arranged more or less in the form of interrupted bands. ..... **achilliæ** John.

**Neaspilota alba** Lw. Fig. 35.

I have specimens from New York and Texas. It has been taken in Pennsylvania, New Jersey, Missouri and Colorado. The adults were

captured on Iron weed (*Vernonia noveboracensis*) and bred by Riley from the seeds of *Vernonia*.

**Neaspilota albidipennis** Lw. Fig. 36.

My specimens are from Pennsylvania and Massachusetts. In New Jersey, the adults were taken on *Vernonia*.

**Neaspilota achilliæ** John. Fig. 37.

I have only two specimens, both from Wood's Hole, Massachusetts. It is reported from Pennsylvania and Georgia and the adults have been taken on Yarrow (*Achillea millefolium*).

Genus **ACROTÆNIA** Lw. 1873.

Genotype, *Acrotænia latipennis* Wd.

Genus **XANTHOMYIA** new genus.

Genotype, *Xanthomyia platyptera* Lw.

The wing is reticulate, very broad, more than half as wide as long, with a strongly convex margin. It is dark gray, almost black at times and with innumerable hyaline droplets throughout. Cross-veins are approximate, perpendicular and parallel. The scutellum bears four bristles.

**Xanthomyia platyptera** Lw. Fig. 38.

This is a gray species with yellow legs and head. A black transverse streak occurs on the border of the eye and the bristles of the front are inserted each in a dark puncture. The thorax is gray pollinose and the black bristles likewise inserted on black spots. The scutellum is variegated brown and yellow, while the abdomen bears four rows of black spots. The wings are reticulate, the stigma black with two hyaline spots. The entire margin of the wing has a more or less continuous row of hyaline spots separated by bands of the dark running to the margin.

All my specimens were taken in New York but it is recorded also from Connecticut.

Genus **EUTRETA** Lw. 1873.

Genotype, *Eutreta sparsa* Lw.

These dark-brown flies are stout with large and broad brown wings. The front is wide and has the usual number of bristles, which are

rather stout and black. The postocular row is composed of short black bristles and somewhat longer white stubble-shaped bristles interspersed. The black scutellum has four black bristles. The wings are a dense, dark-brown color with a narrow white crescent-shaped tip, the brown being minutely punctured with yellowish-white spots.

KEY TO THE SPECIES.

*A.* Vein $R_{4+5}$ is bristly. The stigma is without any yellow punctures but there is a small marginal patch of yellow around the apex of vein $R_1$. The face is very pale with several black spots; the body brown. **sparsa** Wied.

*AA.* Vein $R_{4+5}$ is not bristly and the face is without black spots.

*B.* The apical white crescent of the wing is divided into several sections by spurs of the brown coloring. The stigma has one or two yellow punctures. The body is brown, and somewhat smaller than *sparsa*. ..... **rotundipennis** Lw.

*BB.* The white crescent is complete and the stigma without yellow punctures. There is no marginal yellow patch at the tip of vein $R_1$. The thorax and legs are shining black, the former with white pile. The abdomen is bright reddish brown. ..... **diana** O. S.

**Eutreta sparsa** Wied. Fig. 39.

The specimens are from New York and Nova Scotia and it is reported from Massachusetts, Maine, New Jersey, Pennsylvania, Indiana, Wisconsin, South Dakota, Colorado, California, Washington and Texas. The larvæ live in root galls on goldenrod.

**Eutreta rotundipennis** Lw. Fig. 43.

A single specimen from Plummer's Island, Maryland, was loaned by Mr. R. C. Shannon. It has also been reported from New Jersey. Mr. C. W. Johnson writes me that Loew's type was from Texas rather than "Middle States" as recorded in his Monograph.

**Eutreta diana** O. S. Fig. 41.

I have one specimen from Montana and one from California. It has been taken in Missouri, Nevada, Nebraska and Washington. The larvæ live in galls on *Artemisia tridentata.*

Genus **PARACANTHA** Lw. 1873.

(= *Carpotricha* Lw.)

Genotype, *Paracantha culta* Lw.

The adults are robust, pale brown flies with white hairs. The body is variously spotted with dark brown or black, especially at the

insertion of the bristles. The face and front have several black spots and flecks. The two pairs of lower orbital bristles, the ocellars and the two pairs of vertical bristles are all black and, with the exception of the outer vertical pair, are all stout. A postocular row of small black bristles is intermixed with white ones. All others of the front and occiput are white and weak. The yellow scutellum is covered with white stubble-shaped pile and bears four black spots for the insertion of the bristles. The wing is large, light brown in color and rayed at the margin from the base along the anterior margin to the tip of vein $Cu_1$. A prominent black eye-spot appears in cell $R_5$. Vein $R_{4+5}$ has two or three weak bristles on the upper side of the wing but is distinctly bristly on the lower side.

**Paracantha culta** Wied. Fig. 42.

My specimens are from New Mexico, Georgia, Nebraska, Colorado and Texas. It has also been reported from Washington, Oregon, Idaho, South Dakota, California, Kansas and Carolina.

**Paracantha marginepunctata** Macq.

This was described from material recorded from Baltimore; but with a very meagre description.

Genus **ACIDOGONA** Lw. 1873.

Genotype, *Acidogona melanura* Lw.

Loew points out that the characteristics of this genus are found in "the striking breadth of the forehead, the unusual length of the antennæ, and the comparatively very even face, somewhat retreating below."

**Acidogona melanura** Lw. Fig. 40.

This species is clay-yellow with reticulate wings. The yellow scutellum has four bristles and vein $R_{4+5}$ is distinctly bristly. Loew described the species from material taken in the District of Columbia and I have copied his figure of the wing to include with my figures as I have no specimens, nor any other records of its capture.

Genus **EUROSTA** Lw. 1873.

Genotype, *Eurosta solidaginis* Fitch.

In this genus are found the largest and heaviest of our eastern Trypetidæ. They have reddish-brown bodies and dark reticulate

wings that are more or less finely punctured with yellow and have varying amounts of hyaline on the margins. The front is very broad, three or four times as broad as one eye; cheeks also broad. The dark scutellum has either two or four bristles, while the ovipositor is heavy and conical. The wings are broad with a very obtuse tip and vein $R_{4+5}$ with bristles.

KEY TO THE SPECIES.

*A.* Scutellum with two bristles.

*B.* Conspicuous hyaline indentations are present on the margin of cell $2dM_2$, some of which are as deep as the *r-m* cross-vein.

*C.* There is a large and black elongated spot in cell $R_5$ which fills two thirds of that cell. The margin of the wing is rayed from considerably before the stigma, around the apex to the tip of vein $Cu_1$. There is no single large hyaline triangle occupying the most of cell $Cu_1$ and extending up into the discal cell. **latifrons** Lw.

*CC.* No large and dark elongated spot in cell $R_5$. The margin of the wing may be considered as rayed only at the extreme tip, if at all. A large hyaline triangle is present, margining cell $Cu_1$ and occupying at least two thirds of that cell, and extending up into the discal cell. ..... **solidaginis** Fitch.

*BB.* All marginal indentations in the second $M_2$ cell are minute.

*C.* A triangular hyaline spot on the anterior margin just beyond the stigma. The dark comma mark in the centre of this indentation which is present in the next species is absent here. The ovipositor is more or less attenuated near the apex and finely ridged transversely. The wing is pretty uniformly dark brown with numerous yellow punctures. A very narrow white crescent edges the extreme tip and there is a suggestion of a white marginal indentation at the apex of vein $Cu_2$. ..... **elsa** Daecke.

*CC.* The white hyaline triangular indentation just beyond the stigma has a dark comma mark through it, running from the margin to vein $R_{2+3}$. The ovipositor is smooth and uniformly conical. This species has a small hyaline indentation over the tip of vein $Cu_2$ and also a narrow white crescent on apex. **comma** Wied.

*AA.* Scutellum with four bristles.

*B.* The *r-m* cross-vein is oblique and the stigma has two spots, one yellowish and the other white. Several hyaline spots are more or less rayed about the apex, with a suggestion of a dark spot in cell $R_5$ which shows only in certain lights. The body is somewhat smaller than that of the following species. ..... **conspurcata** Doane.

*BB.* The *r-m* cross-vein is perpendicular, but this species also has two spots in the stigma. The hyaline spots and spaces are smaller than in *conspurcata* and the small yellow punctures are more numerous. **reticulata** Snow.

**Eurosta latifrons** Lw. Fig. 44.

Two specimens were loaned by Mr. C. W. Johnson, one from St. Albans, Vermont, and one from Springfield, Massachusetts. It is reported from Carolina, Connecticut and New Jersey.

**Eurosta solidaginis** Fitch. Fig. 45.

I have many specimens from New York and Ohio. It has, however, a rather wide distribution, being reported from Maine, Connecticut, New Hampshire, New Jersey, Kansas, Minnesota, Nebraska, Idaho, Colorado, Washington and Canada. The larvæ live in the round galls of the goldenrod.

**Eurosta elsa** Daecke. Fig. 46.

My specimens are from Ithaca, Long Island, and Forest Hills, New York, and the species is recorded from Maryland. The larvæ live in root galls of the goldenrod (*Solidago rugosa*).

**Eurosta comma** Wied. Fig. 47.

This species is represented by specimens from Colorado, New York and Maine but occurs also in New Jersey, Connecticut, Maryland, Virginia, Kentucky and Washington. Like *elsa* this species also forms root galls on goldenrod but chooses a different species for its host (*Solidago juncea*).

**Eurosta conspurcata** Doane.

I have specimens from Ithaca and Rock City, New York, and it is reported from New Jersey, New Hampshire and Washington.

**Eurosta reticulata** Snow. Fig. 48.

Dr. A. L. Melander very kindly loaned me a specimen of this species and I have also one from New York State. It has been taken in Massachusetts, Connecticut, Minnesota, South Dakota, Montana and Colorado.

Genus **ICTERICA** Lw. 1873.

Genotype, *Icterica seriata* Lw.

The whole insect, body and wings is a yellowish-brown. The anterior pair of dorso-central bristles is in a line with the anterior pair of supra-alars. The yellow scutellum bears four bristles. The wings are long with more or less parallel margins. The anterior cross-vein is somewhat oblique, that end which touches vein $R_{4+5}$ being furthest

from the base of the wing, while the *m* cross-vein is even more oblique than the *r-m* cross-vein. Vein $R_{4+5}$ may either be bristly or not. Our eastern species have the same general pattern of many yellow droplets on a pale brown background. A brown band margins the wing and most of the breaks and spots in it are of pure hyaline.

KEY TO THE SPECIES.

*A.* Vein $R_{4+5}$ is bristly for over two thirds of its length; while the dark brown or black of the anterior margin begins before the tip of the subcostal vein. This border has no hyaline interruptions between the stigma and the tip of vein $M_{1+2}$, although it may have two or three small yellow ones. The brown network of the centre of the wing is in the form of angular spots, triangles, squares, etc. ..... **seriata** Lw.

*AA.* Vein $R_{4+5}$ with only two or three bristles at the base. The dark brown of the anterior margin begins beyond the tip of the subcostal vein and has four hyaline interruptions between the stigma and the tip of vein $R_{4+5}$. The brown net-work of the centre of the wing is in the form of circles and connections between round spots. ..... **circinata** Lw.

**Icterica seriata** Lw. Fig. 49.

Three specimens are from Ithaca, New York, and it is recorded from Massachusetts, New Jersey, Illinois, Michigan and Nebraska.

**Icterica circinata** Lw. Fig. 50.

My representatives are from Trenton and Westville, New Jersey. It has been taken in New York. Mr. C. W. Johnson reports taking it "quite commonly on the flower heads of a wild sunflower-like plant that grew between high and low tidewater."

Genus **EUARESTA** Lw. 1873.

Genotype, *Euaresta festiva* Lw.

The species of this genus all have reticulate wings whose reticulation extends well over two thirds of the wing. The picture is rayed at the apex, invariably having a large hyaline spot on the margin of cell $R_5$. The scutellum bears four bristles. Vein $R_{4+5}$ is sometimes sparingly bristly, although after examining a long series of several species, I doubt if this character is a constant one in the different members of the genus. These differ from those of the genus *Trypanea* in the shape of the body and particularly in the shape of the abdomen. In *Euaresta* it is heavy and robust, comparatively, and it

is usually wider than the thorax. In the male the abdomen is shorter than the thorax and in the female, sometimes shorter but sometimes as long as the thorax.

KEY TO THE SPECIES.

*A.* The stigma is dark with one or two hyaline or yellow spots.

*B.* Cell $R_5$ has a darker, almost black elongate spot in the brown of the reticulation.

*C.* Cell $R_5$ has a conspicuous hyaline spot above the tip of the *m* cross-vein. The body of the female is 4–5 mm. long, entirely yellow with the exception of the long and tapering black or reddish ovipositor. The wings are hyaline with brown reticulation which is much darker in cells $R_1$ and $R_{2+3}$. ..... **festiva** Lw.

*CC.* Cell $R_5$ has no hyaline spot except the marginal indentations. The body of the female is about 2.5 mm. long. The thorax and head are both gray pollinose while the abdomen is light brown with dark brown posterior edges to the segments and a dark ovipositor. The legs are yellow and the wings quite similar to the preceding with the exceptions already noted. ..... **bella** Lw.

*BB.* Cell $R_5$ has no dark elongate spot in the brown of the reticulation. The body is entirely yellow and about 5–6 mm. long in the female. The ovipositor varies from yellow to reddish-brown. The wings are hyaline with a yellow reticulation which becomes somewhat darker, almost black on the costal border and apex. The hyaline drops are very numerous and exceptionally large. ..... **æqualis** Lw.

*AA.* The stigma is wholly dark like the ground color of the wing, that is, without any hyaline spots.

*B.* The costal cell is clear hyaline without any dark spots.

*C.* A very small, grey pollinose species, with hyaline wings bearing a black pattern. Female 3 mm. long. The wing reticulation differs in having many more small hyaline spots than the next species, especially in cell $R_5$ where there are eight of various sizes among my specimens. ..... **angustipennis** Lw.

*CC.* This species is much larger (female 5 mm.) and yellow. The wings are hyaline with the pattern in yellow or light brown. Cell $R_5$ has at most four hyaline spots. ..... **subpura** John.

*BB.* The costal cell has several dark spots breaking the clear hyaline.

*C.* Cell $R_5$ has a single conspicuous spot immediately above the posterior cross-vein, as well as a few others scattered throughout the cell. There is also a minute hyaline spot in cell $R_1$ beyond the hyaline pyramid. Body 5 mm. long, black, with the head and legs brown. The wings are somewhat milky with black reticulations. ..... **pura** Lw.

*CC.* Cell $R_5$ has two conspicuous spots, one above the *m* cross-vein and

the other directly above the first. Cell $R_1$ is entirely dark beyond the hyaline pyramid. ..... **webbii** Doane.

**Euaresta festiva** Lw. Fig. 51.

I have specimens from Ithaca, New York, and Fremont, Nebraska. It is recorded from Pennsylvania, Connecticut, New Jersey, Virginia, Illinois, Ohio, Quebec and South Dakota.

**Euaresta bella** Lw. Fig. 52.

My material was taken in New York, Nebraska, Illinois and Georgia but it is reported from New Jersey, Iowa, Kansas, Michigan, Tennessee, Wisconsin and Washington. The adults are commonly taken on Ragweed.

**Euaresta æqualis** Lw. Fig. 53.

This species is rather widely distributed since I have specimens from New York, Maryland, Indiana, Nebraska and Washington and records from Virginia, District of Columbia, Pennsylvania, Iowa, Illinois, Ohio, Kansas, Idaho, Colorado, California and New Mexico. It has been reared from cockleburr seed (*Xanthium*).

**Euaresta angustipennis** Lw.
= *Tephritis angustipennis* Lw.

My specimens are from Ottawa, Canada, Nova Scotia, New York and Washington and it has been taken in New Jersey and Alaska.

**Euaresta subpura** John. Fig. 55.

I have specimens from Anglesea, New Jersey, but it is recorded from Wildwood, New Jersey, on Sea burweed (*Xanthium echinatum*).

**Euaresta pura** Lw. Fig. 56.

Specimens from Massachusetts and New York.

**Euaresta webbii** Doane. Fig. 57.

I have one specimen from Dr. A. L. Melander and reports of its capture in Minnesota and Idaho.

Genus **TRYPANEA** Schrank. 1796.

(= *Urellia* Lw.)

Genotype, *Trypanea stellata.*

These are dark gray flies, more or less densely covered with white pollen, whose bodies are quite slender as compared with the species of *Euaresta.* The abdomen is generally longer than the thorax, and

usually not as wide. The wings are hyaline with a black star-shaped pattern on the apex. Occasionally the hyaline of the wing has a shadowy reticulation. The scutellum has either two or four bristles. Vein $R_{4+5}$ is sometimes bristly, and the cross-veins are approximate and perpendicular, while the *m* cross-vein is slightly curved.

KEY TO THE SPECIES.

*A.* Wing without a pale shadowy reticulation besides the dark stellar spot. The scutellum has two long bristles.

*B.* The black spot has eight rays, seven of which reach the margin of the wing. Two hyaline spots are present in the black spot, one at the tip of vein $R_{2+3}$ and the other in cell $R_5$, touching vein $M_{1+2}$ and situated between the cross-veins. The female is 3 mm. long. **daphne** Wied.

*BB.* The dark star has nine rays, eight of which reach the margin. There are two hyaline spots in approximately the same positions as in the preceding. Female 4.5 mm. ..... **dacetoptera** new species.

*AA.* The wing has a pale reticulation over the whole, and with a black stellar spot on the apical half. The scutellum has four bristles. **abstersa** Lw.

**Trypanea daphne** Wied. Fig. 58.

= *Trypanea mevarna* Walk.

= *Trypanea solaris* Loew.

I have specimens from Nebraska and California but reports of its capture in Massachusetts, Rhode Island and Georgia.

**Trypanea abstersa** Lw. Fig. 60.

This collection contains representatives from New York, Oregon and Nebraska. It is reported from Cuba, New Mexico, South Dakota, Iowa, Minnesota and Massachusetts.

**Trypanea dacetoptera** new species. Fig. 59.

A dark pollinose species, with yellow legs and the whole body thickly covered with white hair. Front comparatively broad, one and one half times as wide as one eye, bristles brown. Scutellum gray pollinose with two long yellowish-brown bristles. Abdomen longer than thorax. Ovipositor shining black, flattened, about as long as last two abdominal segments. Wings hyaline with a large stellate spot on the apical half which sends off nine rays of approximately the same width, eight of which reach the margin. The first reaches the margin through the stigma; a second extends to the anterior margin a little beyond the stigma; a third and fourth at the tips of veins $R_{4+5}$ and $M_{1+2}$ respectively; the fifth and sixth through cell $2dM_2$; the seventh covers the *m* cross-vein and the eighth runs more or less parallel to

the seventh, touching the margin in cell $Cu_1$. The ninth arises in the vicinity of the *r-m* cross-vein and extends half way across the discal cell. There is a light streak in cell $R_5$ which margins the *r-m* cross-vein. Besides this, the dark spot encloses two hyaline drops, one at the tip of $R_{2+3}$ and the other in cell $R_5$, touching vein $M_{1+2}$ and situated between the two cross-veins. Vein $R_{4+5}$ is bare. Female is 4.5 mm., male 4 mm. long. One female was taken June 6, 1916, at Karner, New York, by W. T. M. Forbes and the two males are from Rock City, New York, June 10, 1915. Type in Cornell University collection.

Genus **ENSINA** Lw. 1830.

Genotype, *Ensina sonchii* Linn.

The proboscis is geniculated, as long as the head, and with flaps that are much produced, reaching backwards as far as the mentum. The oral edge is strongly produced and there is no stellate edge to the reticulation of the wings.

**Ensina picciola** Bigot. Fig. 61.
(= *Ensina humilis* Lw.)

This is a small gray pollinose species, the female only 2 mm. long. The long geniculated proboscis is its remarkable feature. The scutellum bears two exceedingly long black bristles. The abdomen has two rows of black spots on the dorsum and the hyaline wings have a coarse and diffuse reticulation. The stigma is wholly black. One of my specimens has an extra spur in the middle of the *m* cross-vein. The material is all from Florida, though I have reports of its being taken in Bermuda, Jamaica, Cuba, Tennessee, Mississippi, Kansas, Illinois, Iowa, South Dakota and Colorado.

Genus **EURIBIA** Hendel. 1912.

(= *Tephritis* Lw.)

Genotype, *Euribia arnicæ* Linn.

Although the species of this genus always have reticulate wings, this reticulation is never stellate. The oral opening is projecting and the proboscis is short-geniculate. The yellow scutellum bears four bristles.

KEY TO THE SPECIES.

*A*. The reticulation of the wing is made up, partly of yellow and partly of black, the latter being more or less confined to the stigma (a spot at the end of the subcostal vein and another at the end of vein $R_1$) and in the region of the apex of vein $R_{2+3}$. The body is yellow, somewhat gray pollinose and with a yellow ovipositor. Vein $R_{4+5}$ is bristly.
**fucata** Fabr.

*AA.* The reticulation of the wing is dark brown and black and without any yellow.

*B.* Vein $R_{4+5}$ is bristly. This is a gray insect with pale yellow scutellum. The wings are large and mostly dark brown with minute hyaline spots. The base of the wing is hyaline and there is a conspicuous hyaline triangle beyond the stigma. ..... **geminata** Lw.

*BB.* Vein $R_{4+5}$ is not bristly.

*C.* The apex of the wing has few spots but has a round marginal one in cell $R_5$, two in cell $R_3$ and three in second $M_2$. The reticulation leaves the extreme base hyaline but covers the rest of the wing with many round hyaline spots of various sizes. The black stigma has a hyaline spot. The face is white or pale yellow. **albiceps** Lw.

*CC.* No row of marginal spots around the apex as in the preceding. The body is gray with yellow feet. The wings have a coarse and diffuse reticulation. There is a row of black spots across the wing in the region of the base of cell $R_3$ which forms an indistinct and interrupted band. Otherwise, the wing is practically clear hyaline up to the region of the stigma and *r-m* crossvein. ..... **clathrata** Lw.

**Euribia fucata** Fabr. Fig. 65.

= *Tephritis picturata* Snow.

I have specimens from New Jersey and Jamaica and it is also recorded from Florida.

**Euribia geminata** Lw. Fig. 62.

Messrs. E. T. Cresson and C. W. Johnson loaned me material taken in New Jersey and Pennsylvania.

**Euribia albiceps** Lw. Fig. 63.

After examining seventy-five specimens, I can find no character upon which Loew could establish a good species, *euryptera.* The shape and width of the wing varies greatly and so does the size and proximity of the six hyaline spots which make up the pyramid beyond the stigma. There is also great variation in the number of small spots in the region of the stigma and the pyramid. There seems to be no constancy, however, in the relationships of these variations with each other, so that for as many times as one could pick out a specimen of *euryptera* (with broad wings, small hyaline spots making up the pyramid with considerable space between, and with spots less numerous in the vicinity of the stigma), one could pick out specimens of half a

dozen other species. The wing I have figured would more nearly represent Loew's *euryptera* and shows something of the variation from his *albiceps*. My specimens were collected in New York and Nova Scotia, but the species has been reported from Maine and New Jersey. *T. euryptera* Lw. was described from a single specimen taken at West Point, New York.

**Euribia clathrata** Lw. Fig. 64.

The collection contains an excellent series from Washington and Utah. It is recorded from the Middle States and New Jersey.

BIBLIOGRAPHY.

ALDRICH, J. M. A catalogue of North American Diptera. Smithsonian Misc. Coll. Vol. xlvi, No. 1444, 1905.

ALDRICH, J. M. The Fruit Infesting Forms of the Dipterous Genus *Rhagoletis* with one new species. Can. Ent. 41: 69–73, 4 fig., 1909.

BABB, GEORGE F. Note on *Rhagoletis suavis* Lw. with a Description of the Larva and Puparium. Ent. News 13: 242, 1902.

BEZZI, M. Restaurazione del Genere *Carpomyia* (Rond) A. Costa. Boll. Labor. Zool. de Portici v: 1–34, 1911.

BEZZI, M. Indian Trypaneids (Fruit-flies) in the Collection of the Indian Museum, Calcutta. Memoirs of the Indian Museum III: 52–175, pls. VIII, IX, X, 1914.

BRITTAIN, W. H. AND GOOD, C. A. The Apple Maggot in Nova Scotia. Bull. Dept. Agric. N. S. No. 9, 1917.

BROOKS, F. E. Walnut Husk-Maggot. Bur. Ent. U. S. Dept. Agr. Bull. 992, Nov. 1921.

CAESAR, LAWSON. Insects Attacking Fruit Trees, The Apple Maggot and Cherry Fruit Flies. Ont. Dept. Agric. Bull. 250, 1917.

CHITTENDEN, F. H. The Cherry Fruit Fly (*Rhagoletis cingulata* Lw.). U. S. Dept. Agric. Div. Ent. Bull. 44: 70–75, 2 fig., 1904.

CHITTENDEN, F. H. Some Insects Injurious to Truck Crops. The Parsnip Leaf Miner (*Acidia fratria* Lw.). U. S. Dept. Agric. Bur. Ent. Bull. 82: 9–13, 2 fig., 1909.

COQUILLETT, D. W. New North American Trypetidæ. Can. Ent. xxvi: 71–75, 1894.

COQUILLETT, D. W. Two Dipterous Leaf-miners on Garden Vegetables (*Acidia fratria* Lw.). Insect Life VII: 383, 1895.

COQUILLETT, D. W. Notes and Descriptions of Trypetidæ. Jour. N. Y. Ent. Soc. VII: 259–268, 1899.

COQUILLETT, D. W. The Type-species of the North American Genera of Diptera. Proc. U. S. Nat. Mus. Vol. 37, No. 1719, pp. 499–647, 1910.

CRESSON, E. T. Some Nomenclatorial Notes on the Dipterous Family Trypetidæ. Ent. News 25: 275–279 and 323, 1914.

DAECKE, E. Trypetid Galls and *Eurosta elsa* n. sp. Ent. News Vol. 21, pp. 341–343, 1 pl., 1910.

DOANE, R. W. Notes on Trypetidæ with Descriptions of New Species. Jour. N. Y. Ent. Soc. VII: 177–193, 1899, pls. III–IV.

DOANE, R. W. Additional Notes on Trypetidæ. Jour. N. Y. Ent. Soc. VIII: 47–48, 1900.

FITCH, ASA. First Report on Noxious, Beneficial and other Insects of the State of New York. 1855. Pp. 66–67.

HENDEL, FRIEDRICH. Die Bohrfliegen Südamerikas. Übersicht und Katalog der bisher aus der neotropischen Region beschriebenen Tephritinen. Abhandlungen und Berichte des Königl. Zool. u. Anthr.-Ethn. Mus. zu Dresden 1912 Bd. XIV Nr. 3, 4 Tab.

HENDEL, FRIEDRICH. Die Gattungen der Bohrfliegen (Analytische Uebersicht aller bisher bekannten Gattungen der Tephritinæ). Entomol. Ztg. Wien 33, 1914, 73–98.

ILLINGWORTH, J. F. A Study of the Biology of the Apple Maggot together with an investigation of Methods of Control. Bull. Cornell Univ. Agric. Expt. Sta. No 324: 125–187, 1912–13.

JOHNSON, C. W. Some Notes and Descriptions of seven new species and one new genus of Diptera (*Neaspilota achilleæ*). Ent. News XI: 328, fig. 3, 1900.

JOHNSON, C. W. *Tephritis fucata* Fabr., note of capture. Ent. News XIV: 100, 1903.

JOHNSON, C. W. Notes on the Distribution of some Trypetidæ with Description of a new species. Psyche 16: 113–114, 1909.

LOEW, H. Die Europaeischen Bohrfliegen (Trypetidæ) Wien, 1862, 26 pls.

LOEW, H. Monographs of the Diptera of North America, Vol. I: 49–102, pl. II, 1862; Vol. III: 211–350, pls. X & XI, 1873.

MACQUART, J. Histoire Naturelle des Diptères, Paris v. 2, 1835.

MACQUART, J. Histoire Naturelle Diptères Exotiques nouveaux ou peu connus. Suppl. V, 1854.

MARCOVITCH, S. The Biology of the Juniper Berry Insects with Descriptions of New Species. Ann. Ent. Soc. Amer. 8: 171, pl. xvi, 1915.

MARLATT, C. L. The *Xanthum Trypeta*. Proc. Ent. Soc. Wash. II: No. 1, pp. 40–44, 1890.

OSTEN SACKEN, C. R. Biological Notes on Diptera, *Trypeta polita* Lw. Tr. Amer. Ent. Soc. Vol. II: 301–302, 1868.

OSTEN SACKEN, C. R. Western Diptera. Bull. U. S. Geol. Survey of the Territories, Vol. III, No. 2, pp. 344–348, 1877.

OSTEN SACKEN, C. R. Catalogue of the Described Diptera of North America. Smithsonian Misc. Coll. 270: 188–195, 1878.

PAINE, J. H. The Yellow Currant Fly or Gooseberry Fruit Fly, *Epochra canadensis* Lw. Psyche 19: 139–144, 2 pls., 1912.

PATTON, W. H. Two New Gall-Making Diptera. Can. Ent. XXIX: 247, 1897.

PING, CHI. Some Inhabitants of the Round Gall of Goldenrod. Jour. of Entomology and Zoology of Pomona College, VII: 161–167, 1915, pl.

QUAINTANCE, A. L. The Apple Maggot or "Railroad Worm" (*Rhagoletis* (*Trypeta*) *pomonella* Walsh). U. S. Dept. Agric. Div. Ent. Circ. No. 101: 1–12, 2 fig., 1908.

ROBINEAU-DESVOIDY. Essai sur les Myodaires Mém. par Divers Savants a L'Academie Royale des Sciences de l'Institut de France, Math. et Phys. Vol. II, 1830.

SAY, THOMAS. Some Descriptions of North American Dipterous Insects. Jour. Acad. Nat. Sci. Phil. VI: 185–187, 1830.

SEVERIN, H. P. The Currant Fruit Fly. Bull. Me. Expt. Sta. No. 264, pp. 177–247, pls., 1917.

SMITH, J. B. Catalogue of Insects found in New Jersey, 1890.

SNOW, W. A. Descriptions of North American Trypetidæ, with Notes. Kans. Univ. Quart. Vol. II, No. 3, 1894, pp. 159–174, pls.

SWEZEY, O. H. *Eutreta sparsa* Wied. (Makes galls on shoots of *Latana* in Hawaiian Is.) J. Ec. Ent. VIII: 453, 1915.

THOMPSON, M. T. Three Galls Made by Cyclorrhaphous Flies, *Eurosta reticulata* and *Eutreta sparsa* on roots of Goldenrod. Psyche Vol. XIV, No. 4, pp. 71, 1907.

VAN DER WULP, F. M. Trypetinæ, Biologia Centrali-Americana, Diptera 11: 401–429 , 1899, pls. XI & XII.

WALSH, B. D. First Ann. Report on the Noxious Insects of the State of Illinois, pp. 36–42, 1867.

## EXPLANATION OF PLATES XVIII, XIX.

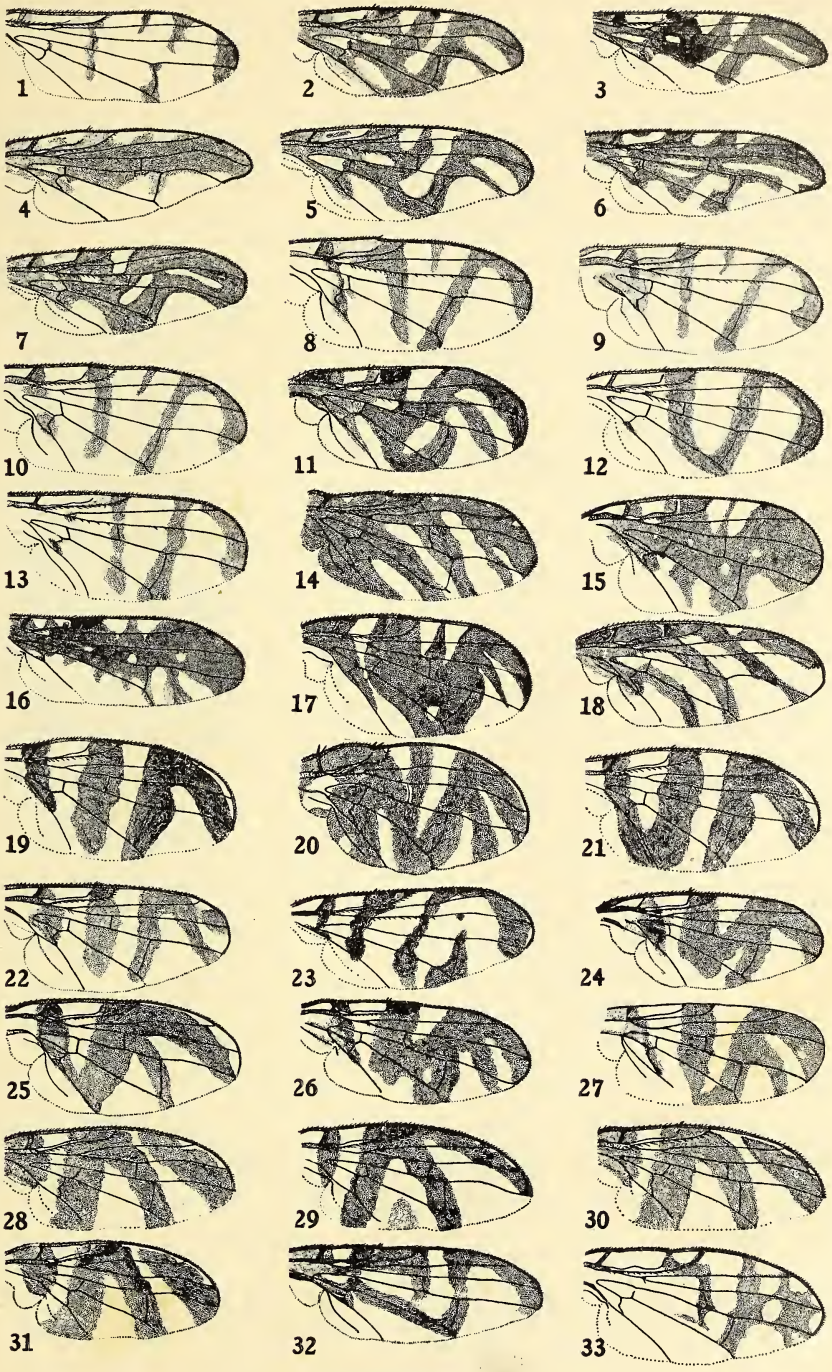
### PLATE XVIII.

FIG. 1. *Aleomyia alpha* n. sp.
FIG. 2. *Straussia longipennis* Wied. var. *perfecta* Lw.
FIG. 3. *Straussia longipennis* Wied. var. *typica* Lw.
FIG. 4. *Straussia longipennis* Wied. var. *longitudinalis* Lw.
FIG. 5. *Straussia longipennis* Wied. var. *vittigera* Lw.
FIG. 6. *Straussia longipennis* Wied. var. *intermedia* Lw.
FIG. 7. *Straussia longipennis* Wied. var. *arculata* Lw.
FIG. 8. *Zonosema electa* Say.
FIG. 9. *Zonosema flavonotata* Macq.
FIG. 10. *Zonosema setosa* Doane.
FIG. 11. *Acidia fratria* Lw.
FIG. 12. *Acidia sigma* n. sp.
FIG. 13. *Phorellia tortilis* Coq.
FIG. 14. *Peronyma sarcinata* Lw.
FIG. 15. *Aciura* (*Eucosmoptera*) *nigricornis* Doane.
FIG. 16. *Aciura* (*Eucosmoptera*) *tetraspina* n. sp.
FIG. 17. *Aciura* (*Eucosmoptera*) *limata* Coq.

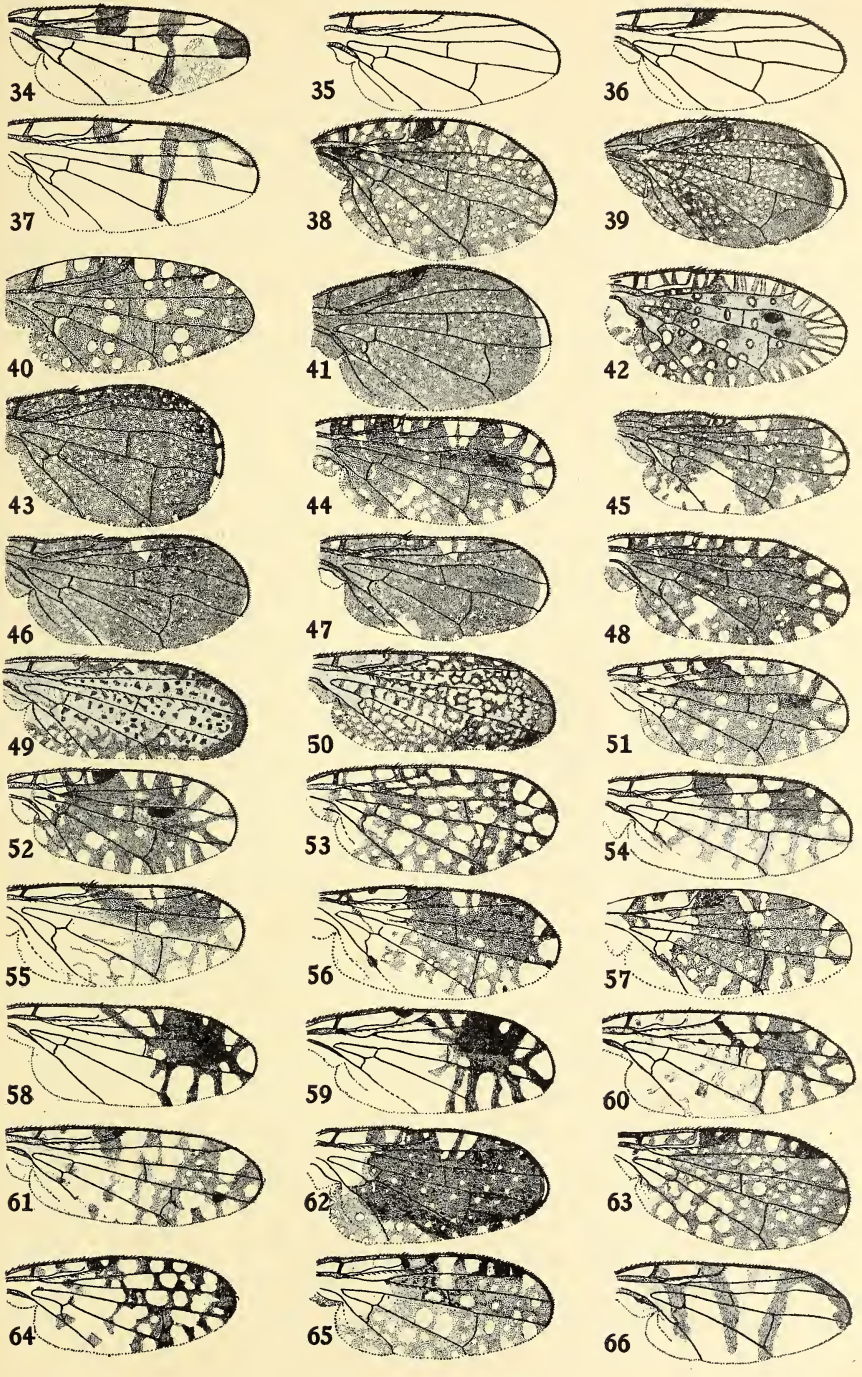
FIG. 18. *Tomoplagia obliqua* Say.
FIG. 19. *Rhagoletis juniperinus* Marc.
FIG. 20. *Stenopa vulnerata* Lw.
FIG. 21. *Rhagoletis tabellaria* Fitch.
FIG. 22. *Rhagoletis cingulata* Lw.
FIG. 23. *Epochra canadensis* Lw.
FIG. 24. *Rhagoletis suavis* Lw.
FIG. 25. *Rhagoletis pomonella* Walsh.
FIG. 26. *Rhagoletis fausta* O. S.
FIG. 27. *Rhagoletis striatella* v. d. W. (after van der Wulp).
FIG. 28. *Procecidochares polita* Lw.
FIG. 29. *Procecidochares penelope* O. S.
FIG. 30. *Procecidochares setigera* Coq.
FIG. 31. *Procecidochares atra* Lw.
FIG. 32. *Terellia palposa* Lw.
FIG. 33. *Terellia vernoniæ* Lw.

PLATE XIX.

FIG. 34. *Terellia florescentiæ* Linn.
FIG. 35. *Neaspilota alba* Lw.
FIG. 36. *Neaspilota albidipennis* Lw.
FIG. 37. *Neaspilota achilliæ* John.
FIG. 38. *Xanthomyia platyptera* Lw.
FIG. 39. *Eutreta sparsa* Wied.
FIG. 40. *Acidogona melanura* Lw.
FIG. 41. *Eutreta diana* O. S.
FIG. 42. *Paracantha culta* Wied.
FIG. 43. *Eutreta rotundipennis* Lw.
FIG. 44. *Eurosta latifrons* Lw.
FIG. 45. *Eurosta solidaginis* Fitch.
FIG. 46. *Eurosta elsa* Daecke.
FIG. 47. *Eurosta comma* Wied.
FIG. 48. *Eurosta reticulata* Snow.
FIG. 49. *Icterica seriata* Lw.
FIG. 50. *Icterica circinata* Lw.
FIG. 51. *Euaresta festiva* Lw.
FIG. 52. *Euaresta bella* Lw.
FIG. 53. *Euaresta æqualis* Lw.
FIG. 54. *Euaresta angustipennis* Lw.
FIG. 55. *Euaresta subpura* John.
FIG. 56. *Euaresta pura* Lw.
FIG. 57. *Euaresta webbii* Doane.
FIG. 58. *Trypanea daphne* Wied.
FIG. 59. *Trypanea dacetoptera* n. sp.
FIG. 60. *Trypanea abstersa* Lw.


1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25
26
27
28
29
30
31
32
33

TRYPETIDAE


34
35
36
37
38
39
40
41
42
43
44
45
46
47
48
49
50
51
52
53
54
55
56
57
58
59
60
61
62
63
64
65
66

TRYPETIDAE

FIG. 61. *Ensina picciola* Bigot.
FIG. 62. *Euribia geminata* Lw.
FIG. 63. *Euribia albiceps* Lw.
FIG. 64. *Euribia clathrata* Lw.
FIG. 65. *Euribia fucata* Fabr.
FIG. 66. *Zonosema electa* Say, n. var.

## A NEW SPECIES OF POLYDRUSUS GERMAR (COLEOP.).

BY LEWIS B. WOODRUFF,

NEW YORK, N. Y.

While on visits to south-central Alabama early in 1921 and 1923 specimens of an Otiorhynchid beetle unknown to me were taken by beating maples. Recently upon attempting to identify them as our eastern *Polydrusus americanus* Gyll., it became apparent that they were structurally very different from that species, as well as smaller and much paler. That led to a careful consideration not only of those species described from our southwestern territory, Lower California, Mexico and Central America, but of European species as well, in the latter case especially because several adventitious species of this and allied genera have already made their appearance here—most likely introduced in nursery stock. The net result is my conviction that the species in question is indigenous and undescribed, and its description follows:

**Polydrusus decoratus** new species.

Oblong oval, compact. Inner wings present, fully developed. Brown to piceous, alutaceous, shining, legs, antennæ and mouth parts somewhat lighter; abdominal segments black. Surface above completely covered by close-set grayish-white, ashy and light brown scales which are squarish or broadly ovate or rounded, the light brown ones on elytra condensed on the disk to form a three lobed patch with a short, broad stem toward but not reaching base. This patch in some specimens is outlined with darker brown scales. There is also a small brown spot at the apical end of the fourth stria. On the thorax these light brown scales form a median and, at base, two lateral longitudinal lines approaching but not reaching apex, in some specimens fusing together over the whole dorsal surface; and on the head they likewise form a median and, back of the eyes, two lateral lines reaching the base, in some specimens confluent across base. Surface below densely covered with whitish spatulate scales, distinctly separated along

gular suture, less densely placed on abdominal segments and legs, those on femora beneath, and on tibiæ predominantly, with an intermingling of ligulate scales; those on last ventral segment hair-like. Antennæ glabrous, rather sparsely and very coarsely hairy, densely so and more finely on elongate oval club; hairs of scape broad and scale-like; scape reaching front margin of thorax, slender, moderately clavate. Joints of funicle obconic, first at least twice as broad and three times as long as second, and much longer than second and third together; second joint twice as long as wide; third as wide as long, hardly more than half as long and much less robust than fourth. Scrobe deep, bending above at a rounded right angle, reaching bottom of beak at so obtuse an angle as to be almost perpendicular to it, but not extending or converging beneath it. Beak short, flat, broadly notched at tip, nasal plate very small; beak but little constricted before eyes, about two thirds length of head, rather thickly clothed with long, erect, bristling, very dark brown and conspicuously broad setæ, broadest at their apex, protruding through its scaly covering, and continued, more sparsely, over head. Eyes moderate, broadly rounded in front, slightly pointed above and below, between these points the arc of the rear margin greatly flattened. Thorax constricted at apical fourth and distinctly wider than long, shorter than head and beak, sides rounded, not globosely, base truncate with narrow margin. Dark brown setæ like those on beak and head, numerous over dorsal surface, somewhat inclined forward. Scutellum distinct, roughly quadrate, about as broad as long, raised above adjoining elytral surfaces by its ashy scaly covering, and bordered with light brown scales which reach it along suture. Elytra much wider than thorax, ventricose, broadest two fifths from apex, their humeri prominent, each with ten deep striæ coarsely and closely impressed with subquadrate punctures, third and fourth striæ slightly sinuate on basal fifth; intervals broad, slightly convex, their convexity obscured by scales, each with a single row of fine, widely spaced punctures along middle bearing dark brown bristling setæ as described above, these setæ somewhat inclined rearward and as long or longer than one half the width of such intervals. Beneath, second ventral at middle almost four times as long as third; first strongly sinuate apically, third slightly so basally. Legs moderate in length, femora strongly clavate, unarmed, the anterior pair a little shorter and stouter than the others. Tibiæ outwardly with a row of widely spaced, blunt spines curving forward, apex strongly mucronate, front and middle pairs bent inward apically. Claws connate at base. Length from front of eyes: 3.10–3.75 mm.; width at humeri: 1.25–1.40 mm.

Holotype ♀, Hazen, Alabama; April 4, 1921. Allotype ♂, same locality and date. Sixty specimens taken by me on *Acer saccharinum* and on neighboring *Quercus primus*. Type in my collection. Paratypes in collections of American Museum of Natural History, United States National Museum, Mr. Charles W. Leng, and Mr. Howard Notman.

From *P. americanus* Gyll. this new species is distinguished by the much paler brown scales of the dorsal patch, which in the former extend along the third and thence by the fourth interval to the base,—

by the spatulate or rounded scales on third and fourth ventral segments, and on scape by ligulate instead of hairy ones; by the lack of the border of white scales about the scutellum which characterizes *americanus,* by the shorter and much less constricted beak, much more perpendicular antennal scrobe, which in *americanus* makes an acute angle with bottom of beak and does not quite reach it,—and in the relative lengths of the first four funicular joints. While the ornamentation of its elytra suggests *americanus,* it seems much more nearly related to *P. peninsularis* Horn, in size, general pale color and form, and especially in the character of the antennal scrobe. It is however at once distinguished by the length of the scape, which in that species, although exceeding the rear of the eyes, does not reach the rear of the head; by the relative lengths of the funicular joints, which in *peninsularis* compare with each other as follows: First about twice length of second, but little longer than second and third together; third cylindrical, a very little longer than wide, and a little shorter than fourth; and by the following diverse characters of the latter, to-wit: Beak about half length of head instead of two thirds as in this new species; thorax about as long as wide instead of shorter, scales of femora ligulate to hairy, not rounded; few dark scales on head, not arranged in rows; the darker scales on elytra in great minority, more or less irregularly placed and not forming a conspicuous dorsal patch; and by the very short and pale erect setæ of head, thorax and elytra as compared with the long, broad and dark ones characterizing *decoratus. Ochreus* (Fall), known from New Mexico, is a yellowish species as its name implies, with a pale green sheen, with which *decoratus* could hardly be confused, the latter entirely lacking the green tint and lustrous effulgence so common in the genus.

This species was found to be fairly abundant on sugar maple at the type locality, and I have no doubt that its host plant there was that tree. If so, it would seem that it should be found further north where that tree prevails.

# PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF DECEMBER 5.

A regular meeting of the New York Entomological Society was held at 8 P.M., on December 5, 1922, in the American Museum of Natural History, Vice-President Harry B. Weiss in the chair, with 20 members and seven visitors present.

The librarian reported accessions.

Mr. Davis announced semi-centennial meeting of Brooklyn Entomological Society on December 14 and invited the members of the New York Entomological Society to be present.

Mr. Mutchler exhibited "New Species of West Indian Lampyridæ," principally from Sierra Maestra of Cuba, and its culminating Pico Torquino, 7,900 feet in height. Many had been collected by Mr. S. C. Bruner, of the Experimental Station at Santiago de las Vegas. Fifteen species were included and with the 35 previously described, made an addition of about 40 per cent. to the described species.

Mr. Weiss spoke on "Gypsy Moth Work in New Jersey," the third year of which is now in progress. The success of this work covering 1,200 square miles, scouting for egg masses and creosoting them when found, besides spraying and banding the trees, has been phenomenal. The 30,003,039 egg masses found the first year was reduced to 909 the second year and still further reduction will reward the third year's work. The cost has been about $250,000 annually, about 200 men being employed, besides 21 spraying machines, costing $6,500 each; but if the work can be continued for a few more years, the pest will be exterminated at less cost than in Massachusetts.

Dr. Bequaert gave "A Comprehensive Account of Diptera whose Larvæ Parasitize Vertebrates" in which these Diptera were first shown to belong to several natural groups, then classified according to the nature of their parasitism, and according to their relationship. Five boxes were used to show the adults and many vials to show the larvæ. In this way the parasites of the horse, rhinoceros, elephant, camel, sheep, antelopes, reindeer, cattle, rabbits and man were shown, down or up to one from DeWitt Miller's skin. Finally the distribution was considered, showing Africa, with its numerous large mammals, to be the most favored region at present, and the fossil remains to be scanty.

The discussion by Messrs. Davis, Weiss, Engelhardt and Dr. Sturtevant brought out many additional facts.

Mr. Dickerson read part of a letter from Jan Obenberger, questioning the reference of our species of *Rhæboscelis,* which may be more correctly placed in *Paragrilus.*

Mr. Engelhardt spoke of the possibility of *Albuna pyramidalis* occurring in the Evening Primrose.

Mr. Davis exhibited a living *Endrotes ventricosus.*

Mr. Schott exhibited a European ladybug, *Bulæa lichatschovi* Hummel, found at Rutherford, N. J., November 10, 1922, eating the scale *Chionaspis evonymi.*

MEETING OF DECEMBER 19.

A regular meeting of the New York Entomological Society was held at 8 P.M., on December 19, 1922, in the American Museum of Natural History, vice-president Harry B. Weiss in the chair, with 15 members and seven visitors present.

The following new members were elected: on nomination at previous meeting by Mr. Watson,

Cecil D. Wright, 73 West 92d St.,
Arthur J. Fenton, 73 West 92d St.,

and on nomination by Mr. Watson,

F. Martin Brown, 2665 Briggs Ave.,

and on nomination by Mr. Barber,

Ferdinand A. Varrelman, American Museum of Natural History,

the by-laws having been suspended to permit of the last two being included in the Academy Directory for 1923.

Mr. Woodruff spoke of the desirability of commencing meetings at 8 P.M., and closing at 10 P.M., to avoid unnecessary expense and labor for the Museum.

The chairman appointed as a Nominating Committee, Messrs. Notman, Dickerson and Watson.

On motion by the Treasurer, Mr. J. W. Smith was dropped for non-payment of dues.

Mr. Notman spoke on "Notes on the tribe Osoriini," using a collection from various parts of the world and blackboard drawings as illustration. He explained in detail the parts used in the classification, number of tarsal joints, form of head, relative position of eye and antenna, pilosity of labrum, etc. He commented on the antennæ being in some species geniculate, in others not; on the last joint of palpi being subulate in one genus, the eyes lacking in two more, the scutellum lacking in another, and still other great structural differences being observable in one tribe, some of which indicated a transition to the tribe Oxytelini.

Mr. Sherman having taken the chair and called for general notes, Mr. Davis exhibited some large plant lice.

Mr. Alfred Emerson, present as a visitor, spoke of Syrphid flies attacking such plant lice.

Mr. Weiss exhibited the remains of a roach embedded in the paper on which one of his separates was printed. Mr. Appell, on invitation from the chair, expressed his pleasure at being present and recalled the time when, as a boy of 15, he first guided Mr. Davis about the woods near Washington.

Mr. Emerson spoke briefly on his Termite studies.

Messrs. Weiss, Davis and Sherman expressed disapproval of the circulars mailed from Portland, Oregon, reflecting upon Dr. Howard.

Dr. Bequaert announced the election of Mr. Charles W. Leng, as Honorary President of Brooklyn Entomological Society, at its semi-centennial celebration on Dec. 14, Mr. Leng being the survivor of the six incorporators of that Society in 1885.

MEETING OF JANUARY 2.

The annual meeting of the New York Entomological Society was held at 8 P.M., on January 2, 1923, in the American Museum of Natural History, President John D. Sherman, Jr., in the chair, with 19 members and six visitors present.

Mr. Notman, for the committee, nominated the following officers for the year 1923:

*President*—Harry B. Weiss.
*Vice-President*—Frank E. Lutz.
*Secretary*—Charles W. Leng.
*Treasurer*—William T. Davis.
*Librarian*—Frank E. Watson.

*Executive Committee.*

H. G. Barber, Joseph Bequaert,
G. P. Engelhardt, G. C. Hall,
L. B. Woodruff.

*Publication Committee.*

John D. Sherman, Jr.,
E. L. Dickerson,
Howard Notman,
C. E. Olsen.

There being no other nominations, the secretary, on motion duly made and seconded, cast one affirmative ballot, thereby electing these nominees.

Mr. Weiss took the chair and briefly thanked the Society for the honor conferred upon him. Mr. Woodruff proposed as active members:

Mr. Walter Everts, 245 West 69th St.
Dr. Charles A. Leale, 500 Madison Ave.

Mr. Alfred Emerson, of the University of Pittsburgh, made an interesting address, illustrated by lantern slides, on "Ecological Relations of Termites," based on observations at Kartabo. He pointed out first the conditions found in the nests, viz.: comparative permanence, constant high temperature, plentiful supply of refuse, eggs, etc., the nest material itself organic, all necessarily with protection from enemies. The nests he classified as either subterranean, arboreal or pendulous. He then passed to Wassmann's classification of the inhabitants into four categories. 1°. Those living in the

galleries, not with the termites, the bees *Englosa* and *Trigona* and eggs of lizards for example. 2°. Those living in the galleries with termites, synechtrans or persecuted intruders, of which he instanced a curious snake and certain Pselaphid beetles, and synoeketes, or ignored intruders, including many Histerid and Aleocharid beetles. 3°. True Symphiles, taken care of by the termites, and often physogastric in form; many of these were shown and many remarkable features described, the enlarged pronotum, the permanently recurved abdomen, and the abdominal appendages, especially developed in the beetle *Spirachtha mirabilis* Schiodte. 4°. True ecto- or ento-parasites including flies near to Phorids, Braconid wasps, and fungus.

Many interesting facts are omitted in the brief summary of Mr. Emerson's remarks.

In the discussion that followed Dr. Lutz referred to the abdominal appendages discovered by Mr. Mutchler, in the Lycid beetle *Thonalmus* from Montserrat, and Messrs. Notman, Davis, Olsen, Engelhardt, Weiss and Woodruff also contributed facts.

Dr. Bequaert discussed at some length the comparison between South American termite guests as described by Mr. Emerson, and those he had observed in Africa.

Prof. James S. Hine, of Columbus, present as a guest, spoke briefly of his work in Tabanidæ, especially of the unnecessary number of genera.

Mr. Angell exhibited some unusual forms of *Cicindela repanda*.

Mr. Schott exhibited a second specimen of the European Coccinellid *Bulæa lichatschovi* Hummel found at West Orange, N. J., December 19.

# JOURNAL

OF THE

# New York Entomological Society.

Published quarterly by the Society, at Prince & Lemon Sts., Lancaster, Pa., and New York City. All communications relating to the JOURNAL should be sent to the Publication Committee, New York Entomological Society, American Museum of Natural History, New York City; all subscriptions to the Treasurer, Wm. T. Davis, 146 Stuyvesant Place, New Brighton State Is., New York, and all books and pamphlets to the Librarian, Frank E. Watson, American Museum of Natural History, New York City. Terms for subscription, $2.00 per year, strictly in advance. ***Please make all checks, money-orders, or drafts payable to NEW YORK ENTOMOLOGICAL SOCIETY***


Authors of each contribution to the JOURNAL shall be entitled to 25 separates of such contribution without change of form. If a larger number be desired they will be supplied at the following rates, provided notice is sent to the Publication Committee before the page proof has been corrected:

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 8¢ | for | each | reprint | of a | 1 | to | 4 | pp. article. |
| 10¢ | " | " | " | " | 5 | " | 8 | " " |
| 12¢ | " | " | " | " | 9 | " | 12 | " " |
| 16¢ | " | " | " | " | 13 | " | 16 | " " |
| 20¢ | " | " | " | " | 17 | " | 20 | " " |
| 24¢ | " | " | " | " | 21 | " | 24 | " " |
| 26¢ | " | " | " | " | 25 | " | 28 | " " |
| 28¢ | " | " | " | " | 29 | " | 32 | " " |

Two cents additional for each half-tone print. Covers on same paper as the JOURNAL, with printed title page, $1.50 for 50 covers, and 2 cents for each additional cover.

**Authors whose papers are illustrated with text-figures or full-page plates, will be required to supply the electrotypes or pay the cost of making the same by the Journal and also to pay the cost of printing full-page plates on coated paper, when advisable, at the rate of about seven dollars per plate. Halftones must be printed on coated paper.**

# THE NEW YORK ENTOMOLOGICAL SOCIETY

Organized June 29, 1892.—Incorporated June 7, 1893.

---

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Eighth Ave.

Annual dues for Active Members, $3.00.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

---

## Officers for the Year 1923

*President*, HARRY B. WEISS ..... 19 N. 7th Ave., New Brunswick, N. J.

*Vice-President*, FRANK E. LUTZ ..... American Museum of Natural History, New York.

*Secretary*, CHAS. W. LENG ..... Staten Island Museum, St. George, S. I., N. Y.

*Treasurer*, WM. T. DAVIS ..... 146 Stuyvesant Place, New Brighton, Staten Island, N. Y.

*Librarian*, FRANK E. WATSON ..... American Museum of Natural History, New York

*Curator*, A. J. MUTCHLER ..... American Museum of Natural History, New York

*EXECUTIVE COMMITTEE*

H. G. BARBER, GEO. P. ENGELHARDT, L. B. WOODRUFF,
JOS. BEQUAERT, G. C. HALL.

*PUBLICATION COMMITTEE.*

J. D. SHERMAN, JR. E. L. DICKERSON, HOWARD NOTMAN,
C. E. OLSEN.

*AUDITING COMMITTEE.*

E. SHOEMAKER, E. L. BELL, A. S. NICOLAY.

*FIELD COMMITTEE.*

A. S. NICOLAY, JOS. BEQUAERT.

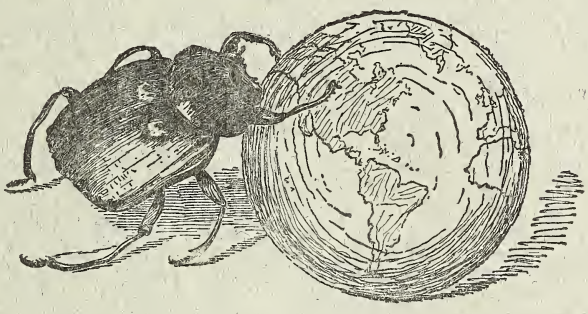
*DELEGATE TO THE N. Y. ACADEMY OF SCIENCES.*

WILLIAM T. DAVIS.

Vol. XXXI. December, 1923 No. 4

# JOURNAL OF THE New York Entomological Society

Devoted to Entomology in General



DECEMBER, 1923

Edited by HOWARD NOTMAN



---

Published Quarterly by the Society.

LANCASTER, PA. NEW YORK CITY

1923

(Entered April 21, 1904, at Lancaster, Pa., as second-class matter under Act of Congress of July 16, 1894.)

LANCASTER PRESS, INC.

# CONTENTS



NOTICE:—Volume XXXI, Number 3 of the Journal of the New York Entomological Society was published on October 22nd, 1923.

JOURNAL

OF THE

New York Entomological Society.

VOL. XXXI. DECEMBER, 1923. No. 4

# SAW-FLIES OF THE KATMAI EXPEDITION TO ALASKA.[1]

BY ALEX. D. MACGILLIVRAY,

URBANA, ILL.

The saw-flies collected by Professor James S. Hine, a member of the Katmai Expedition of the National Geographical Society, were submitted to me for identification and description. The number of species included in the collection made by Professor Hine as well as in that of Professor Trevor Kincaid of the Harriman Alaska Expedition is remarkably small.

**Emphytus gemitus** new species.

Female. Body black with the labrum, tegulæ, middle of basal plates, and the tergum and sternum of the fourth abdominal segment, white; legs beyond the apices of the coxæ rufous; clypeus deeply roundly emarginate; supraclypeal area elevated; ocellar basin broad and shallow, median fovea pit-like; vertical furrows distinct; ocellar and interocellar furrows not prominent; ocellar furrow not connected with the interocellar basin; antennæ with the first segment of the flagellum slightly longer than either of the subequal second and third segments; saw-guides with the margins converging, the ventral margin convex, broadly convexly rounded to a point above at apex; wings hyaline, the veins and stigma brownish. Length, 8 mm.

*Habitat:* Kodiak, Alaska; Jas. S. Hine, collector.

This species is near *mellipes* Norton, the form of the head will separate them.

**Dolerus nyctelius** new species.

Male. Body black with the knees, the tibiæ, the tarsi more or less, and abdominal segments one to three, rufous; the antennæ with the first and second

[1] Contributions from the Entomological Laboratories of the University of Illinois. No. 80.

segments of the flagellum subequal, the second longer than the third; the front, frontal orbits, and the postocellar area closely finely punctate; the vertical orbits convex, sparsely punctate; with a more or less distinct transverse furrow; the median lobe of the mesonotum uniformly punctate; the lateral lobes of the mesonotum sparsely punctate and with an impunctate area extending to median lobes; the mesoscutellum coarsely closely punctate; the appendages of the scutellum smooth; the wings hyaline, the veins and the stigma black. Length, 6 mm.

*Habitat:* Kodiak, Alaska; Jas. S. Hine, collector.

This species runs to *icterus* MacG.

**Dolerus nivatus** new species.

Female. Body black with abdominal segments one to four and a part of five, rufous; the antennæ with the first segment of the flagellum longer than the second, the second and third subequal; the front and frontal orbits finely closely punctate; the postocellar area finely densely punctate, more coarsely than the front and finer than the vertical orbits; the vertical furrow distinct, long, linear; the ventral end of each antennal furrow almost obsolete; the median lobe of the mesonotum finely punctate, more closely but not more coarsely than the lateral lobes, punctures uniform in size; the median lobes of the mesonotum with an impunctate area; the mesoscutellum densely punctate; the appendage of the scutellum large, striations not prominent; the mesopleura coarsely punctate, the pectus densely finely punctate; the saw-guides retracted, the dorsal and ventral margins convergent, the distal portion bluntly pointed; the wings hyaline, the veins and the stigma black. Length, 12 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

This species runs to *unicolor* Beauv.

**Dolerus nemorosus** new species.

Female. Body black with the abdominal segments one to three, the protibiæ and mesotibiæ, and the protarsi, rufous; the head and thorax with short white setæ; the antennæ with the first segment of the antennæ longer than the second, the second slightly longer than the third; the front, the frontal orbits, the vertical orbits, and the postocellar area uniformly punctate; the head not with a transverse furrow extending from the vertical orbits behind the compound eyes; the vertical furrows punctiform; the median lobe of the mesonotum finely punctate, not with a row of large punctures on each side; the lateral lobes of the mesonotum and mesoscutellum finely punctate; the mesopleura coarsely punctate; the saw-guides with the dorsal and ventral margins straight, parallel, the distal portion oblique, long, convex, bluntly pointed above; the wings hyaline, the veins and the stigma black. Length, 7.5 mm.

This species is related to the *nudus* group of species.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

**Dolerus negotiosus** new species.

Male. Body black with abdominal segments two and three and a part of the fourth, the knees, and the greater part of the prothoracic tibiæ, rufous;

antennæ with the third and fourth segments subequal, the fourth slightly longer than the fifth; front and facial orbits uniformly densely punctate, postocellar area coarsely punctate, vertical furrows elongate pit-like depressions, about twice as long as wide; an impunctate area on each vertical orbit, extending to vertical furrow; median lobe of mesonotum coarsely punctate, each lateral portion more densely punctate than the mesal; lateral lobes of mesonotum densely punctate, not with an impunctate area; mesopleura densely punctate; wings hyaline with the veins, stigma, and costa blackish. Length, 7 mm.

*Habitat:* Savonoski, Katmai, and Kodiak, Alaska; Jas. S. Hine, collector.

This species is related to *knowi, nemorosus,* and *numerosus.*

**Dolerus elderi** Kincaid.

Valdez, Alaska. July 1919.

**Rhogogastera respectus** new species.

Female. Body green with a black spot on the vertex, surrounding ocelli, except edges of frontal furrow, the mesonotum except two marks on the median lobe and one each on each lateral lobe of the mesonotum, the mesoscutellum, the dorsal aspect of the abdomen, except a narrow band at each lateral margin, a black line on the femora, tibiæ, and the apices of the tarsal segments; clypeus roundly emarginate; antennæ with the second segment of the flagellum larger than the third, the two together subequal in length to the first; frontal furrow not deep, interrupted; head polished, impunctate; saw-guides straight above, slightly convex below, convexly rounded at apex; wings hyaline, veins black, stigma and costa black. Length, 11 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

**Rhogogastera respersus** new species.

Male. Body green with the upper side of the antennæ, the antennal furrows in part, the interocellar furrow, an irregular line extending around the ventral side of the green elevation bearing the median ocellus, a small spot on each side of the clypeus, narrow lines on the sutures of the notum and plura, and narrow lines on the caudal margin of the cephalic abdominal terga, and a line on the femora and tibiæ, black; antennæ with the second and third segments of the flagellum subequal and together longer than the first segment; clypeus shallowly emarginate; frontal furrow short and deep, reaching only half way to the median ocellus; wings hyaline, veins brownish, stigma and costa white. Length, 10 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

This species is similar to the preceding, from which it is readily separated by the difference in color and the structure of the frontal furrow.

**Tenthredo nigricollis** Kirby.

Katmai, Alaska, July 1917.

**Tenthredo variegata** Norton.

Katmai, Alaska, June 1917.

**Tenthredo scævola** Cresson.

Katmai, July 1917, and Kodiak, Alaska, June 1917.

**Tenthredo rusticula** new species.

Male. Body black with the labrum, the clypeus, sometimes with only a spot on each side, the mandibles, the genal orbits, a short spot on the mesopleura, the pectus, the extent of the pale spot variable, a spot above the posterior coxæ, and the sides of the basal plates, yellowish-white; the coxæ all broadly beneath, the front and middle legs beneath, the metafemora, and the metatibiæ, reddish-yellow, paler on the anterior legs; the abdomen with most of the tergum of the first segment, all of segments two to five, and a part of the sixth, rufous, the sterna all pale; antennæ with the first segments of the flagellum distinctly longer than the second but not as long as the second and third together; head polished, impunctate; the clypeus roundly emarginate; the front with a deep furrow; the thorax finely punctured. Length, 10 mm.

*Habitat:* Katmai and Kodiak, Alaska; Jas. S. Hine, collector.

This species is similar to *lacticincta* Cresson.

**Tenthredo retinentia** new species.

Female. Body black with the labrum, clypeus, genal orbits, extending onto the frontal and occipital orbits, a minute dot at the meso-caudal angle of each compound eye, the angles of the pronotum, the tegulæ, the front legs, except a small portion of the proximal ends of the procoxæ, the median legs, except black on the mesocoxæ, and the hind legs beyond the metacoxæ, the legs tending toward rufous, yellowish-white; abdomen rufous beyond the third segment; head roughened but not distinctly punctured; front with a broad roughened depression; clypeus broadly emarginate; antennæ with the second segment of the flagellum longer than the third, the second and third together subequal in length to the first; the thorax finely punctured; the saw-guides bluntly rounded, the dorsal margin straight; wings hyaline, the stigma and the proximal portions of the veins pale. Length, 12 mm.

*Habitat:* Kodiak, Alaska; Jas. S. Hine, collector.

This species is similar to *montana* Provancher.

**Tenthredo regula** new species.

Female. Body black with the labrum, clypeus, and mandibles yellowish-white; the legs beyond the trochanters rufous; antennæ short, the first segment of the flagellum longer than the second and nearly as long as the second and third together; the clypeus broadly roundly emarginate; head setiferous and finely punctured; the frontal furrow deep, extending to the median ocellus, irregular; the mesonotum and mesoscutellum finely punctured; saw-guides on

dorsal and ventral margins straight, bluntly rounded at apex; wings hyaline, the veins and the stigma black. Length, 12 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

This species falls near *erythromera* Provancher.

**Tenthredo requieta** new species.

Female. Body black with the mandibles inconspicuously yellow-white; legs beyond the trochanters rufous; antennæ short, the second and third segments of the flagellum subequal, together slightly longer than the first, the second two-thirds the length of the first; the clypeus squarely deeply emarginate; head setiferous, finely punctured; the frontal furrow deep, broadly concave, extending to the median ocellus; the mesonotum and mesoscutellum finely punctured; the saw-guides with the dorsal margin straight and the ventral margin convex, obliquely rounded at apex; wings hyaline, the veins including the costa black, the stigma and the anal veins pale. Length, 10 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

This species is very similar to the preceding in general coloration.

**Tenthredo refuga** new species.

Female. Body black with the labrum, clypeus, mandibles, genal orbits, extending onto the occipital orbits, minute spot at the meso-caudal angles of the compound eyes, sometimes very small, collar, tegulæ, a spot above the posterior coxæ, sides of the basal plates, and the legs beyond the coxæ beneath, inclined more or less to rufous on the posterior pair, yellowish-white; the black line on the femora slightly interrupted on the profemora, strongly on the mesofemora, and very broadly on the metafemora; antennæ short, second and third segments of the flagellum subequal, together subequal in length to the first; the clypeus squarely deeply emarginate; head polished with fine punctures; the frontal depression prominent, extending to median ocellus, sides large, declivous, straight; mesonotum and mesoscutellum punctured; the saw-guides with dorsal margin straight, the ventral margin straight, obliquely rounded at distal portion; wings hyaline, veins brown, stigma and costa paler. Length, 10 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

This species falls near *atracosta* MacG.

**Tenthredo retroversa** new species.

Male. Body black with the labrum, clypeus, mandibles, genal orbits, minute dot at meso-caudal angle of compound eyes, and spot above posterior coxæ, yellowish-white; legs pale, the profemora yellowish with a black line above on proximal half, extending onto lower surface, protibiæ and protarsi entirely yellowish, shaded with rufous, metafemora rufous beneath, black line above, interrupted near distal end, mesotibiæ and mesotarsi rufous, metafemora except a black line above on proximal one-fourth, and metatibiæ and metatarsi rufous; abdomen beyond the middle of the first segment rufous; antennæ with the flagellum indistinctly rufous, the first segment elongate, distinctly longer than the second,

the second and third subequal; the clypeus roundly emarginate; frontal furrow shallow, rounded; wings hyaline, veins brownish, stigma and costa pale. Length, 9 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

This species is near *semirufus* MacG.

**Tenthredo reliquia** new species.

Female. Body black with the labrum, clypeus, mandibles, genal orbits, extending broadly onto the occipital orbits, the collar, the tegulæ, spot above the posterior coxæ, and the sides of the basal plates, yellowish-white; the antennæ, a spot on each frontal orbit, the occipital orbits, the vertical orbits, connected by a narrow band across the postocellar area, sometimes covering most of the frontal area, a V on the mesonotum, the mesoscutellum, the sides of the mesonotum, large spot on the mesopleura, the legs, the basal plates, and the abdomen beyond the third segment, including the saw-guides, rufous; abdominal segments one to three sometimes with a rufous spot on each side; antennæ with the second and third segments of the flagellum subequal and together subequal to the first segment; clypeus angularly emarginate; saw-guides with the dorsal margin straight, the ventral margin slightly convex, bluntly rounded below at apex; wings hyaline, the veins including the costa, rufous, the stigma darker. Length, 11 mm.

*Habitat:* Katmai, Alaska; Jas. S, Hine, collector.

This species resembles *redimacula* MacG., closely.

**Tenthredo resticula** new species.

Female. Body rufous with the labrum, clypeus, mandibles, genal orbits, collar, tegulæ, edge of metapleura, spot above posterior coxæ, and sides of basal plates, yellowish-white; the prothorax in great part, a small spot near the middle of each lateral lobe of the mesonotum, the pectus, sometimes at middle only, the sterna of abdominal segments one to three, black; dorsal portion of the antennæ sometimes infuscated; antennæ with the second and third segments of the flagellum subequal and together not quite as long as the first segment; clypeus roundly emarginate; saw-guides straight above, oblique below, and broadly convexly rounded at apex. Length, 11 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

This species is very similar to *macgillivrayi* Smulyan.

**Trichiosoma aleutiana** Cresson.

Katmai, Alaska. July 1917.

**Pontania destricta** new species.

Female. Body black with the labrum, clypeus, mandibles, genal orbits slightly, the collar, and the tegulæ, white; the legs beyond the apices of the coxæ resinous; the clypeus almost truncate; the supraclypeal area convex; the pentagonal area hardly defined, the frontal ridge wanting, the ocellar area flat, the median fovea slightly depressed and located between the antennæ, ventral

end of ocellar area limited by a V-shaped elevation; vertical, ocellar, and interocellar furrows wanting; head and thorax finely sparsely roughened; saw-guides with the dorsal and the ventral margins convergent, the distal end oblique, concave, bluntly pointed above; cerci not as long as the saw-guides; wings hyaline, the veins and the stigma pale. Length, 4 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

This species falls in tables near *cressoni* Marlatt.

**Pachynematus affinis** Marlatt.

Katmai, Alaska. June 1917.

**Amauronematus veneficus** new species.

Female. Body rufous with the fronto-clypeal suture, the ventral portions of the antennal furrows, widely expanded above the antennæ, an irregular area about the ocelli, the antennæ, a large spot on each lobe of the mesonotum, the caudal portion of the mesoscutellum, the metascutellum, an inverted V-shaped mark on the pectus, an elongated spot on the proximal part of the underside of the femora, the basal plates, abdominal terga one to six, the cephalic third of the seventh segment, and the margins of the saw-guides, black; the pentagonal area with rounded bounding ridges; the median fovea large, round; the frontal crest short, not broken; the vertical and interocellar furrows deep, linear; ocellar furrow wanting; antennæ with the first segment of the flagellum shorter than the second, the second and third segments subequal; the saw-guides with the dorsal margin oblique, the ventral margin convex, converging rapidly to a blunt point at apex; the wings yellow, the veins and the stigma pale. Length, 9 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

The coloration of the body and the structure of the head will differentiate this species.

**Amauronematus ventosus** new species.

Female. Body rufous or resinous with the supraclypeal area, the ventral portion of each antennal furrow, a spot about the ocelli, a spot on the postocellar area, the antennæ, a large spot on each lobe of the mesonotum, the mesoscutellum except two minute dots, the metanotum, the metascutellum, a broad line on each side of the pectus, the metapleura, the basal plates, and the abdomen, except the two caudal segments, black; the clypeus shallowly emarginate; the antennæ with the three proximal segments of the flagellum subequal; the supraclypeal area nearly flat; the pentagonal area not well defined, a distinct furrow extending from the median ocellus to the supraclypeal area, deeply dividing the frontal crest and with a minute median fovea at its ventral end; the saw-guides with the dorsal margin straight, the ventral margin convex, bluntly obliquely pointed above; the wings yellowish, the veins and the stigma pale. Length, 7 mm.

*Habitat:* Valdez, Alaska; Jas. S. Hine, collector.

This species is closely related to the preceding, the form of the frontal crest will separate them.

**Amauronematus veridicus** new species.

Female. Body rufous with the labrum, clypeus, mandibles, supraclypeal area, genal orbits, ventral half of frontal orbits, spot about ocelli, caudal aspect of head in part, two proximal segments of the antennæ, a spot on the median lobe of the mesonotum, the caudal portion of the mesoscutellum, the metascutellum, the sides of the pronotum, the lateral and ventral aspect of the mesothorax and metathorax, and the coxæ, black; the clypeus narrowly shallowly roundly emarginate; antennæ with the first segment of the flagellum shorter than the second; the pentagonal area not distinct, the frontal crest elevated, broken, median fovea linear; head and thorax setiferous; the saw-guides stout, with strongly equally convergent dorsal and ventral margins, the dorsal slightly concave, the ventral convex, bluntly pointed; the wings yellow, the veins and stigma resinous. Length, 7.5 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

This species is near *isolatus* Kincaid.

**Pteronidea shumagensis** Kincaid.

Katmai, Alaska. June 1917.

**Pteronidea erratus** new species.

Female. Body rufous throughout, first and second pairs of legs shading more or less through whitish to resinous; clypeus broadly shallowly emarginate, the emargination distinctly broader than the lobes, the lobes rounded; pentagonal area prominent with strongly elevated bounding walls; frontal crest strong, unbroken; the median fovea a large circular depression; the median ocellus located on an elevation within the walls of the pentagonal area, the elevation with a circular depression on the ventral side of the median ocellus; the ocellar furrow indistinct, the interocellar furrow wanting; the postocellar area with a median depression; the antennæ with the first segment of the flagellum subequal or shorter than the second; the saw-guides retracted, the distal portion angularly pointed; the wings hyaline, inclined to brownish, the stigma and veins brownish. Length, 9 mm.

*Habitat:* Kodiak, Alaska; Jas. S. Hine, collector.

This species belongs near *unicolor* Dyar.

**Pteronidea excessus** new species.

Female. Body resinous with the basal plates, terga of segments one to six for the most part, and the margins of the saw-guides, black; the legs lighter in color than the remainder of the body; the clypeus roundly emarginate, the clypeal lobes large, angular; the pentagonal area distinct, not prominent; the frontal crest short, not strongly raised, not broken; the median fovea an elongate depression, more than twice as long as broad; antennæ with the first and second segments of the flagellum subequal; head and thorax polished; the saw-guides with the dorsal margin straight, converging just at end, the ventral margin long, obliquely rounded to a point at apex above; the wings hyaline, the veins and stigma pale. Length, 5 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

This species differs from the preceding in coloration only in the black of the abdomen.

**Pteronidea effrenatus** new species.

Female. Body rufous with indications of a spot about the ocelli, a spot on each of the lobes of the mesonotum, sometimes wanting, the metascutellum, the basal plates, and abdominal terga one to six, the width of the bars on the caudal segments varying from a small spot to one covering most of the segment, black; parts of the head and legs resinous or whitish; antennæ with the first segment of the flagellum not quite as long as the second; the clypeus narrowly shallowly roundly emarginate; the clypeal lobes as broad as the emargination, rounded; pentagonal area distinct, walls sharply elevated ridges; frontal crest short, distinct, unbroken; the median fovea a distinct depression, distinctly longer than broad; area enclosed by the walls of the pentagonal area flat, a small concavity on the ventral side of the median ocellus; the saw-guides stout, the dorsal margin straight, the ventral margin regularly convex, oblique on the distal portion to a blunt point above; the wings hyaline, the stigma and the veins pale. Length, 7 mm.

*Habitat:* Katmai, Alaska; Jas. S. Hine, collector.

This species is similar to the preceding, the coloration, the median fovea, or the saw-guides will serve to differentiate them.

## BACKYARD COLLECTING IN RAMSEY, N. J.

By Chris. E. Olsen,

West Nyack, N. Y.

Being particularly interested in Cicadellidæ, it was my privilege to examine a boxful, including a few species of other families, collected by Dr. Frank E. Lutz over a period of several years. This collecting was restricted to his backyard at Ramsey, northern New Jersey, at an altitude of about 400 feet. A good deal of interesting material was found in this lot, much of which had not been reported from the State before, while others were listed only by single records and in many cases from quite the other end of New Jersey. It seems advisable to give the list in full with annotations to the more interesting species. Although some of these are quite common insects, nevertheless, their distribution within the state of New Jersey is apparently little known. Names in parenthesis are those used in Prof. John B. Smith's Catalogue of the Insects of New Jersey, 3d Edition, 1910.

1545a **Monecphora bicincta ignipecta** Fitch (1 specimen).
August 11, '17. This is reported now and then in the eastern states as far north as Pennsylvania, New Jersey, and Massachusetts.

1546 **Aphrophora quadrinotata** Say. (2 specimens).
August 3–11, '17.

1570 **Ceresa diceros** (Say.) (1 specimen).
August 7, '17.

1572 **Ceresa bubalus** (Fabricius) (3 specimens).
August, September, '17–'18.

1579 **Ceresa borealis** Fairmaire (3 specimens).
July 17–31, '17–'18.

1719 **Publilia concava** (Say.) (1 specimen).
August 11, '17.

1735 **Enchenopa binotata** (Say.) (1 specimen).
July 17, '18.

1765–1 **Agallia lingulata** (Olsen) M. S. (Bull. Bkl. Ent. So. XVII, p. 127, December, 1922) (1 specimen).
June 18, '18. Manuscript description of this species was in preparation when this specimen was examined. It materially assisted in corroborating the description, being the second female known to the writer and incidently extended its distribution into the state of New Jersey.

1767 **Agallia sanguinolenta** (Provancher).

1778 **Idiocerus pallidus** Fitch (1 specimen).
July 20, '17. A single previous record from Staten Island, N. Y. (This island has been included in the New Jersey list.)

1793 **Idiocerus scurra** (Germar) (3 specimens).
July 4–20, '17.

1802 **Idiocerus fitchi** Van Duzee (1 specimen).
*Idiocerus maculipennis* Fitch.
August 8, '18. This is the second record of this common leafhopper which is likely to be found in any part of the State; a former record is Jamesburg.

1821 **Macropsis** (*Pediopsis*) **trimaculata** (Fitch) (1 specimen).
June 29, '18. John B. Smith in "Insects of New Jersey," Second Edition, 1899, mentions this as being "Common in New York doubtlessly also in New Jersey" and again in Third Edition 1910, he notes "Sure to occur in New Jersey." There is no doubt that this insect is common in New Jersey and must have been collected often, but perhaps thought too common to be recorded. This seems to be the first authentic record.

1864 **Graphocephala** (*Diedrocephela*) **coccinea** (Forster) (5 specimens).
July–September, '17–'18.

1874 **Dræculacephala mollipes** (Say.) (17 specimens).
June–August, '14–'18.

1879 **Dræculacephala noveboracensis** (Fitch) (2 specimens).
July 23–26, '17–'18.

1897 **Gypona 8-lineata** (Say.) (17 specimens).
July–August, '14–'18.

1936 **Acucephalus albifrons** (Linnæus) (5 specimens).
July 16–20, '18.

1940 **Xestocephalus pulicarius** Van Duzee (11 specimens).
July 26, '17. Previously mentioned as "probable in New Jersey."

1983 **Scaphoideus auronitens** Provancher.

1991 **Scaphoideus productus** Osborn (3 specimens).
July, August, '17–'18. First actual records, although reported from surrounding states.

1996 **Scaphoideus immistus** (Say.) (9 specimens).
July–August, '17–'18.

1997 **Scaphoideus melanotus** Osborn (1 specimen).
August 5, 1918. A good addition to the State List of New Jersey previously reported south and west of the state.

2023 **Platymetopius frontalis** Van Duzee (1 specimen).
Sept. 13, '18.

2063 **Deltocephalus inimicus** (Say.) (23 specimens).
June–August, '18.

2132 **Euscelis** (*Athysanus*) **striolus** (Fallen) (5 specimens).
June–August, '18.

2138 **Euscelis uhleri** (Ball) (1 specimen).
*Athysanus plutonius* Uhler.
June 29, '18.

2156 **Euscelis** (*Athysanus*) **curtisii** (Fitch) (2 specimens).
July–September, '17.

2181 **Eutettix strobi** (Fitch) (2 specimens).
July–September, '17.

2228 **Phlepsius irroratus** (Say.) (22 specimens).
June–September, '17–'20.

2246 **Phlepsius solidaginis** (Walker) (4 specimens).
*Phlepsius humidus* Van Duzee.
August 5–7, '17–'19.

2265 **Thamnotettix clitellarius** (Say.) (7 specimens).
June 20–27, '17.

2314 **Thamnotettix nigrifrons** (Forbes) (11 specimens).
*Thamnotettix perpunctata* Van Duzee.
June–September, '17–'18.

2326 **Chlorotettix spatulatus** Osborn and Ball (2 specimens).
August 5–21, '17–'18. A male taken in 1917 and a female in 1918. These are the first to be reported from New Jersey. Other localities are Tennessee and North Carolina.

2327 **Chlorotettix tergatus** (Fitch) (5 specimens).
July 31 to August 5, '17–'18.

2329 **Chlorotettix viridius** Van Duzee (3 specimens).
July 20, '17.

2331 **Chlorotettix galbanatus** Van Duzee (4 specimens).
July 16–20, '17. First authentic records.

2358 **Cicadula variata** (Fallen) (74 specimens).
Taken from June to August, 1917. None were taken in any other year. Upon examining the field notes it was found that they were all collected at light. This method of collecting had not been practiced at other times.

2393 **Dikraneura fieberi** (Loew) (3 specimens).
July 31, '17–'18.
*Dikraneura* sp. (3 specimens). July–August, '18.

2421 **Empoasca mali** (Le Baron) (9 specimens).
July–August, '17–'18.

2422 **Empoasca flavescens** (Fabricius) (1 specimen).
July 31, '17. First record for New Jersey of this widely distributed species. *Empoasca* sp. (1 specimen). July 31, '17 (perhaps same as preceding).

2430a **Empoa querci** var. **gillettei** Van Duzee.
*Empoa bifasciata* Gillette and Baker.
July 12–20, '17. Although there is hardly a trace of the crossbands in some of these specimens it is possible that all four belong to the above mentioned species.

## THE LIFE HISTORY OF THANAOS FUNERALIS SCUD. & BURG. (LEPIDOPTERA; HESPERIIDÆ).

By Karl R. Coolidge,

Hollywood, Calif.

*Thanaos funeralis* is a common butterfly in Southern California, ranging eastward into Arizona, Texas and Colorado. In the vicinity of Los Angeles it is one of the earliest butterflies of Spring, appearing sometimes during the first week of February, but normally is not out in full force until the middle of March.

It is here triple brooded, the first brood waning about the middle of April and disappearing in early May. From the middle of May until late in June members of the second flight are emerging, and in late August and September those of the third appear. As with other species of *Thanaos* that are double or triple brooded, the first brood is by far the largest in point of numbers, the third brood especially being a scanty one. I have found but three food-plants:

Fabaceæ.

*Hosackia glabra* Torrey. Deerweed. This is the usual food-plant, all three generations using it.

*Medicago sativa* Linn. Alfalfa. I have noted examples of the fall generation ovipositing on this plant.

HYDROPHYLLACEÆ.

*Nemophila membranacea.* Snow Flakes. In Chino Canyon, on the Colorado Desert, members of the first brood were found ovipositing on the upper surfaces of the leaves.

The eggs are usually deposited on the under surfaces of the leaves, occasionally on the upper, and sometimes even on the stem. Though a swift and wary species, the females of *funeralis* when ovipositing become so intent upon their maternal performances that they are quite oblivious to any movement about them, and while examining a sprig of *Hosackia* I have had a female alight on it and deposit an egg even while I was endeavoring to capture her with my hand. In hatching the young larvæ eat out irregular jagged holes in the summits of the eggs, only devouring sufficient of the shell to make their escape. Following is a time record of the transitions:

Eggs laid April 13th.
Hatched April 22d.
Larvæ passed first moult April 27th.
Larvæ passed second moult May 4th.
Larvæ passed third moult May 9th.
Larvæ passed fourth moult May 14th.
Larvæ pupated May 19th.
Imagoes emerged June 14th.

The newly hatched larvæ are exceedingly active, scampering about anxiously until locating leaves that meet with their full approval. In the first instar the larvæ seem to attack only the surfaces of the leaves, both upper and lower.

In the later stages the usual type of *Thanaoid* nest is constructed, and the larvæ feed mainly—perhaps in Nature entirely, by night. Pupation occurs in the last larval nest.

Whether, as in Eastern species of *Thanaos,* the larvæ of the first brood destined to produce the generation of the following spring, hibernate in the last instar is a point I have not been able to settle, as all the larvæ I have procured pupated and emerged as the second brood. So too, whether the larvæ of the second and third broods hibernate is problematical.

Scudder (Butt. New Eng., Vol. 2, p. 1449, 1889) states of the larvæ of *Thanaos* that the apically expanded bristles of the earlier instars are replaced by short sharp hairs upon the assumption of the fourth

stage; but this does not hold true of *funeralis,* in which the fungiform hairs persist to pupation.

*The Egg.*—Subspherical, the base squarely docked, the sides narrowing upwards only slightly except towards the extreme summit, which is rather broadly rounded. A series of rather high, compressed longitudinal ribs, pellucid, ranging from base to, or nearly to, the micropyle depression in a slightly sinuous course. These ribs .12 mm. equidistant in the middle and .03 mm. in height. Between them a series of delicately raised cross ribs, .02 mm. apart, straight, and where they strike the main ribs they give to them a beaded appearance. The surface between the longitudinal ribs gently concave, minutely punctate. The longitudinal ribs varying in number, from twelve to sixteen. The micropyle in a flat slight depression, .14 mm. in diameter, consisting of a minute circular central cell bounded by large roundish-oval cells, and still larger oval-angular cells surrounding these. The minute central cell, .005 mm. in diameter; the surrounding roundish-oval cells, .01 mm. in length; the larger oval-angular cells, .018 mm. Surface of egg covered with a multitude of excessively fine roundish raised cells, quite uniform, .002 mm. in diameter. Color, when first laid, a very pale green, almost white. Changing in about forty hours to a distinct lemon yellow, and after forty-eight hours more to a conspicuous orange, with the longitudinal ribs remaining a saffron yellow; finally, just before hatching, to a deep brown. Height, .64 mm.; broadest in the middle of the lower half, .66 mm.; breadth at base, .56 mm.

*First Instar.*—Head and body uniform orange brown. Head, .44 mm. in diameter, orbicular, roughly granulated, and bearing some simple scattered tapering and apically expanding hairs, about .06 mm. in length; ocelli black. The dorsal shield of first thoracic segment small and obscure, a slight shade darker than the body. On the body there are four series of apically expanding bristles, as follows: An infrastigmatal series, one to a segment on the thoracic segments, placed in the middle; two to a segment on the abdominal segments, one placed before and one just after the middle of the segment. Those of the abdominal segments .04 mm. in length, and with the tips .02 mm. in diameter; those of the thoracic segments a little longer and less expanded at the tips. A suprastigmatal series, situated directly above

the spiracles, two each on the thoracic segments, placed close together, but only one on each of the abdominal segments. A lateral series, one each on all the segments, placed posteriorly. A supralateral series, one to a segment, placed anteriorly on the abdominal segments, but posteriorly on the thoracic, where they tend to become subdorsal. The bristles of these last three rows shorter than those of the infrastigmatals, being only .02 mm. in height, with the expanded tips .025 mm. in diameter. Length, 1.6 mm.; width at first thoracic segment, .32 mm.; width at anal segment, .24 mm.

*Second Instar.*—Head now pitchy black, .70 mm. in diameter, roughly corrugated, but slightly bilobed. Head studded with numerous short-crooked clavate hairs, white, thickly but minutely spiculiferous, and but .03 mm. in height. Dorsal shield of first thoracic pale green, smooth, without hairs. The body studded with short white hairs of the same nature as those of the head, and of the same length. The segmental folds of each segment distinct. Color of body a uniform bright lemon yellow, but as the stage develops a more and more greenish coloration is assumed, until finally the lemon yellow is completely obscured by a green almost the exact color of the upper surfaces of the leaves of *Hosackia*. Ventral surface and prolegs concolorous with body above. Legs semi-opaque, very pale yellow. Length, immediately after first moult, 3. mm.; width at first thoracic segment, .60 mm.; width at anal segment, .42 mm.

*Third Instar.*—Head, 1.34 mm. in diameter, but slightly bilobed, corrugated, piceous black, thickly studded with irregular filament-like white hairs, .05 mm. in length on the average. Fore part of first thoracic segment smooth, pale yellow. Dorsal shield gray green. Body thickly covered with white hairs, tipped at the ends with saucers. These hairs but .03 mm. in height and of the same diameter at tips, and arranged in fairly regular transverse series. The tubercles from which these body hairs arise pale yellowish green. A few long sharp white hairs fringing the anal segment, these .20 mm. in length. Color of body greenish yellow. A dark green dorsal line. A trace of a greenish white lateral line, narrow, and not sharply defined. Spiracles pale straw yellow, suboval, inconspicuous, .03 mm. in diameter. Ventral surface and prolegs concolorous with body above. Legs semi-opaque, pale yellow brown. Length, 6.10 mm.; width at first thoracic, 1. mm.; width at anal segment, .94 mm.

*Fourth Instar.*—Head, 2.04 mm. in diameter, piceous black, but slightly bilobed, heavily corrugated. As before, head densely studded with spiculiferous filament-like white hairs, now .08 mm. in length on the average. Fore part of first thoracic segment greenish yellow, smooth. Dorsal shield green. As before, body profusely studded with fungiform white hairs, arranged in more or less regular transverse series. These hairs are now .04 mm. in height, .03 mm. in width at the saucer-tipped ends, and arise from pale green-yellow tubercles. Some of the fungiform hairs, especially along the posterior edge of the anal segment, are as long as .10 mm. Anal segment with some long fine sharp hairs, white and spiculiferous, some as long as .28 mm. Color of body grass green; the segmental sutures yellow, giving as a whole a blotched yellow-green coloration to the body. The lateral line narrow, greenish white, not distinct nor prominent, but developing more and more strongly as the stage proceeds. A greenish-white stripe, indistinct and crenate, along subventral ridge. Spiracles suboval, pale straw yellow, inconspicuous, .04 mm. in diameter. Ventral surface and prolegs concolorous with body. Legs pale yellow brown. Length, just after moult, 9. mm.; width at first thoracic, 1.70 mm.; width at anal segment, 1.40 mm.

*Fifth Instar.*—Head 3.70 mm. in diameter, well rounded, subquadrate, the sides fully rounded, the summit laterally angulated and forming by a slight median excision of the center a slightly elevated laterad submammillate prominence. Head in color brown black, but this coloration is obscured in the following way: A conspicuous orange blotch on either upper prominence; this is scarcely interrupted by a frontal crescent of the ground color of head from a second, but slightly smaller orange spot laterally on each side of face; below this, on the lateral front corner of face, a third smaller roundish concolorous spot. These three spots may be more or less confluent, but in most individuals are distinctly separated. Sometimes a still smaller fourth spot, roundish and of the same color, on the lower lateral posterior angle. Ocelli black fuscous; labrum, base of antennæ and labium pale. Head strongly vermiculate with short white hairs arising from minute pale tubercles; these hairs plumose, varying slightly in size, but average .12 mm. in length. Only a few low inconspicuous red-brown tubercles on summit of head laterally, these but .03 mm. in height. Body largest

at 3d, 4th, and 5th abdominal segments, tapering with considerable uniformity in either direction, but more rapidly at the extremities. Last abdominal segment well and rather strongly rounded. As before, body studded with fungiform white hairs, of slightly varying sizes, arising from rounded pale green-yellow tubercles arranged in more or less regular transverse rows. The largest of these hairs but .10 mm. in height, and .05 mm. in diameter at their saucer-tipped ends. Anal segment with a posterior fringe of fine sharp colorless spiculiferous hairs, of varying sizes, some as long as .40 mm., others but .14 mm. The segments of body divided into four subsegments, the anterior one much the widest, covering the whole half of segment, as wide as the other three together. The other three subequal and occupying posterior half of segment. The broad anterior subsegment with a dorsal division separating off a posterior portion of same width as hinder sections. A laterodorsal series of chitinous annuli, placed in middle of anterior half of each segment, smooth, dark green, .08 mm. in diameter. A laterostigmatal series of similar annuli placed directly above the stigmata, slightly smaller than the laterodorsals, but .05 mm. in diameter. A ventrostigmatal series, two to a segment near together, one in advance of the middle and the other a little behind the middle. Spiracles long oval, pale straw yellow, but slightly elevated, inconspicuous, .12 mm. in diameter. Color of body pale green, yellowish in all the wrinkles, and with a pale-yellowish bloom to all the surface, caused by the profusion of minute hairs. The dorsal line not prominent, fine, even, dark green. The lateral stripe fine, even, white or very pale yellow, fairly conspicuous. As the stage develops this line is slightly interrupted on the abdominal segments with a small blotch of orange, consisting of two fine vertical streaks, close together, on the segmental sutures. But this lateral line tends to become subobsolete on the thoracic segments, sometimes being but faintly represented, then again wholly lacking, and is usually also wanting on the last abdominal segment. A subventral yellowish stripe, even, narrow, not very prominent. First thoracic segment pale yellowish, smooth, hairless. Ventral surface a rather brilliant blue; legs pale yellow green, slightly infuscated at their tips; prolegs pale green. Length, just after moult, 17. mm.; at maturity, 24 mm. Width at first thoracic segment, 2.80 mm.; at anal segment, 2.10 mm.

*Pupa.*—Of the usual generic type. In color a vivid green, but with the wing cases and sometimes the abdomen clouded with creamish. The whole body, excepting the wing cases, but especially on the anterior half, covered with pale tapering wavy sharp hairs, .30 mm. in length on the average. Prothoracic stigmata prominent, velvety black. The cremastral spine pyramidal, truncate, longitudinally and irregularly sulcate; the cremastral hooklets .30 mm. in length, stout, castaneous. Spiracles long oval, .20 mm. in length, .08 mm. in their greatest width, with a slightly fuscous areola; the spiracles not at all prominent. The tongue case only very slightly extending beyond the tips of the wings. Length, 18.5 mm. Greatest height of thorax, 5.5 mm.; greatest height of abdomen, 4.7 mm.; width at eyes, 4.5 mm.; width at basal wing tubercles, 5.5 mm. Suspended by a median girdle, very loose but strong, and a Y-shaped posterior attachment.

## THE IMMATURE STAGES OF THE CATNIP LEAF-HOPPER (EUPTERYX MELISSÆ CURTIS).

By M. D. LEONARD and G. W. BARBER,
Albany, N. Y., and the Bureau of Entomology.

On October 27, 1919, the writers found a small patch of catnip (*Nepeta cataria* L.) on Inner Brewster Island in Boston Harbor. The plants were infested by a small leafhopper which was present in all stages in great abundance. The feeding of the insects had resulted in a characteristic yellowish-white discoloration of the leaves and injury to the plants was becoming apparent. Some of the infested material was collected and brought to the laboratory where the several nymphal stages were readily separated.

Eggs were found in considerable abundance in the petiole of the leaves. They were inserted at a slight angle or nearly parallel with the petiole, the cap apparently being flush with the surface. Egg-punctures could be readily distinguished by means of a small brownish discoloration of the epidermis.

Adults were submitted to both Prof. Herbert Osborn and Mr. W. L. McAtee who identified them as *Eupteryx melissæ* Curtis, as understood by McAtee (Ent. News, 30: 182–183, 1919).

Little is known of the life-history or habits of this species. The

insect has previously been recorded in the United States from New York (Van Duzee, Bull. Buffalo Soc. Nat. Sci., 10: 511, 1912), California (Baker, Invert. Pac., 1: 8, 1903), Pennsylvania and Maryland (McAtee, *l.c.*). No food plants are mentioned. In Europe where it has long been known, the species is common on various plants of the family Labiatæ. Buckton (Mon. Brit., Cicadæ, 2: 128–130, 1891) in his discussion of *E. melissæ* states that there are probably two broods annually. He records finding the insect in October on garden mint and afterwards above the roots of the same plant throughout the winter and into the following spring. In January, 1887, he found active young nymphs after extremely low temperatures and after snow had been on the ground for five weeks. He states that he was unable to find autumn eggs. In the latitude of Massachusetts the insect undoubtedly spends the winter in the adult stage in the protection of leaves or trash on the ground. The writers were unable to gather any data on the length of time required by the insect to pass through its various stages.

*The Egg.*—(Fig. 1.) Length, .85 mm.; width, .17 mm.; pale translucent whitish, as time of hatching approaches becoming tinged with yellow and the eye spots of the embryo distinctly red; cylindrical, shining, somewhat curved, bluntly rounded at posterior end and tapering slightly, and more sharply pointed at the anterior end.

*Stage I.*—(Fig. 2.) Length, .92 mm.; width across eyes, .18 mm.; color, pale yellowish; eyes reddish brown; antennæ, except basal segments, claws and extreme tip of beak, dusky.

*Stage II.*—(Fig. 3.) Length, 1.16 mm.; practically same as first stage excepting hind border of meso- and metathorax more concave and laterally expanded.

*Stage III.*—(Fig. 4.) Length, 1.4 mm.; width across eyes, .34 mm.; pale greenish yellow; eyes pale, slightly tinged with gray; setigerous tubercles on thorax slightly darkened, on abdomen not so. Wing-pads becoming apparent. Hairs long and whitish. Third and fourth segments of beak tinged with dusky.

*Stage IV.*—(Fig. 5.) Length, 2.1 mm.; width across eyes, .46 mm.; pale yellowish; eyes grayish, slightly tinged with green. Setigerous tubercles darkened; those on fifth and sixth abdominal segments not so. Light to dark brown markings on head and thorax as shown in figure. Wing-pads extend back nearly to fourth abdominal segment. Third and fourth segments of beak tinged with dusky.

*Stage V.*—(Fig. 6.) Length, 2.5 mm.; width across eyes, .57 mm. Above greenish yellow, irregularly mottled with light and dark brown as shown in figure. Hairs pale; setigerous tubercles darkened; those of fifth and sixth abdominal segments whitish. Below pale yellowish green; legs and eighth and ninth abdominal segments more greenish; remainder of venter tinged with cream color. Ninth segment of venter with a somewhat dusky stripe either side of the median line. Face below disc similarly marked. Second to fourth segments of beak tinged with dusky. Wing-pads extend back to fifth abdominal segment.

*Adult.*—(Fig. 7.) Following is the redescription of the species by McAtee (*l.c.*): "Head evenly and fully rounded both laterally and vertically. Length of vertex: interocular width:: 6:10. General color of upper surfaces of body and of the legs pale yellow; of forewings delicate green fading toward apex; eyes yellowish green. Head with 2 smaller spots on front, 2 larger on transition from front to vertex, and one of about same size on middle of hind margin, black. All of these spots vary from round to V-shaped or quadrangular; hence do not have the importance in distinguishing species assigned to them by European authors. Pronotum with two black spots, just behind median spot on vertex, and one lying just behind and to the side of each of these. Most of disc of pronotum covered by a greenish fuscous cloud, nearly touching the black spots. A dimly visible brown line connects the black spots, and, being a little more conspicuous at the ends, forms a curved brown dash, to the outer side of each of the posterior pair of dots. Scutellum with two pairs of black dots, the anterior larger and more separated.

"Forewings with irregular greenish fuscous markings, the color deepest at periphery (like blots the center of which has been sucked up), as follows: One larger and a few smaller on inner anterior angle of forewing, three larger (the median decidedly so) on main body of clavus and a long narrow one along whole claval suture; between second and third sectors, three, of which the anterior is largest; and one just outside latter on costa. The veins of the apical cells are margined with brown clouds and there are two black spots near exterior border of wing at a point two-thirds of the distance from base.

"Long triangular mark on cheeks below insertion of antennæ,

lower surface of thorax and entire abdomen black, the segments of latter margined posteriorly (sometimes very broadly) with yellow. Last ventral segment yellow, genitalia chiefly yellow in male, mostly black in female. Tarsi and apex of beak black. Length 3–3.25 mm."

### EXPLANATION OF PLATES.

#### PLATE XX.

Fig. 1. Egg.
Fig. 2. First stage nymph.
Fig. 3. Second stage nymph.
Fig. 4. Third stage nymph.
Fig. 5. Fourth stage nymph.
Fig. 6. Fifth stage nymph.
Fig. 7. Adult.

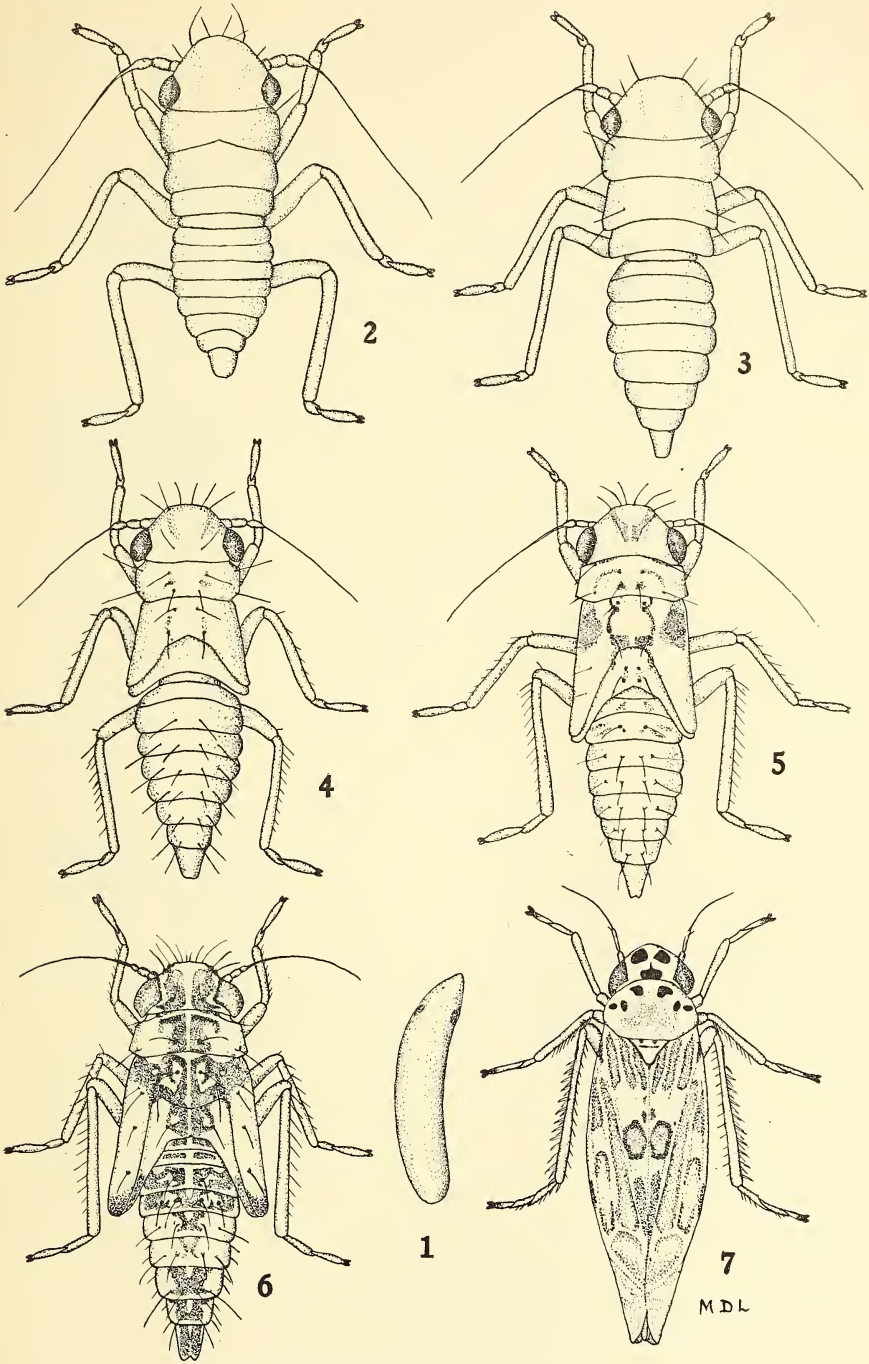
#### PLATE XXI.

Fig. 8. Fore wing.
Fig. 9. Hind wing.
Fig. 10. Face of adult.
Fig. 11. Genitalia of female.
Fig. 12. Genitalia of male.

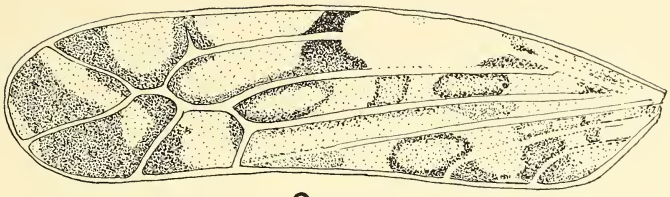
## NEW SPECIES AND SYNOPSIS OF STATIRA.

BY CHARLES W. LENG,
STATEN ISLAND, N. Y.

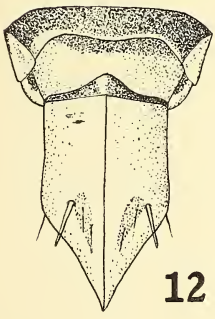
Mr. Charles Liebeck of Philadelphia sent me a few months ago seven specimens of *Statira* which he had found to be undescribed. These specimens led to my examining other species of the genus in the collections of the American Museum of Natural History, also in those of Mr. Charles Schaeffer, who has described several species, and of Mr. William T. Davis. There is some difficulty in using the synopsis by Dr. Horn. All our species have the last joint of the antennæ elongate and all have more or less setigerous punctuation of the elytra. Dr. Horn's synopsis was primarily based upon this punctuation which, as Mr. Schaeffer has already indicated (Brooklyn Mus. Sci. Bull., I: 175), is difficult to observe accurately. I have therefore tried to prepare a synopsis by which the species may be separated without using the punctures as a primary character. It is as follows:



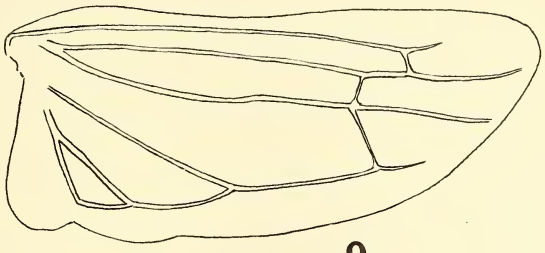

EUPTERYX MELISSÆ CURTIS



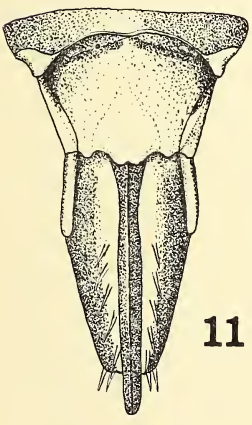
8



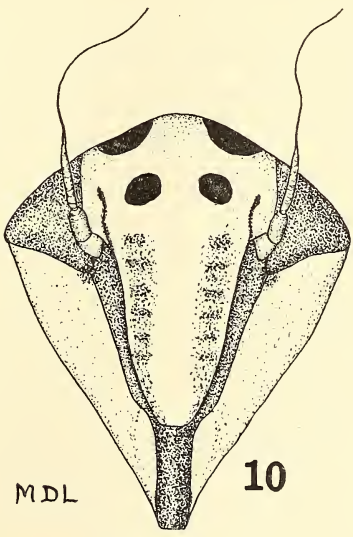
12



9



11




10

EUPTERYX MELISSÆ CURTIS

SYNOPSIS OF STATIRA.

Elytra testaceous with median fascia and scutellar spot black, Mexico and Brownsville, Texas.....**pulchella** Mäkl.

Elytra blue or greenish blue..... 1.

Elytra brown or piceous black.....2.

1. Head black, thorax reddish; setigerous punctures of elytra numerous, Georgia, Alabama, Florida, 7 to 9.5 mm.....**croceicollis** Mäkl.

Head and thorax reddish; setigerous punctures of elytra few, Florida and Alabama, 9.5 mm.....**liebecki** new species.

2. Tibiæ sulcate on the outer edge.....3.

Tibiæ rounded, not sulcate on outer edge.....4.

3. Tibiæ sulcate below apical half only.....5.

Tibiæ sulcate nearly their entire length.....6.

5. Setigerous punctures of elytra few, mostly on third interval, Lower California, 7 to 11 mm.....**subnitida** Lec.

Setigerous punctures more numerous, eyes less approximate; head, thorax, scutellum and legs rufo-testaceous, elytra and abdomen piceous, Lower California, 7.5 mm.....**colorata** Fall.

6. Setigerous punctures of alternate elytral intervals numerous; elytra shining piceous; thorax densely punctate, dull, paler than elytra, Texas, 7 to 9 mm.....**simulans** Schffr.

Setigerous punctures of alternate elytral intervals numerous; elytra and thorax unicolorous, brown, subopaque, Arizona, 6 to 9.5 mm. **pluripunctata** Horn.

4. Pronotum shining.....7.

Pronotum opaque.....8.

7. Pronotum yellow, head and elytra piceous; setigerous punctures few, Pennsylvania, Maryland, Indiana, Kentucky, 7 to 8 mm....**resplendens** Melsh.

Upper surface nearly unicolorous, brown or piceous.....9.

9. Brown; third, fifth, and seventh intervals with setigerous punctures, Arizona, 11 mm.....**robusta** Schffr.

Black; third and fifth intervals with many setigerous punctures, Louisiana, Georgia, Florida, 7.5 to 10 mm.....**basalis** Horn.

Color varying from brown to black; third and fifth intervals with few setigerous punctures, Vermont to Florida and Texas, 6.5 to 8 mm. **gagatina** Melsh.

8. Setigerous punctures numerous on first, third, fifth, and seventh elytral intervals; smaller, thorax opaque, Arizona, 9 to 10.5 mm....**opacicollis** Horn.

Setigerous punctures as in preceding; larger, more robust, thorax opaque, scabrous, Arizona, 12.5 to 14 mm.....**huachucæ** Schffr.

Setigerous punctures absent from the middle and partly the base of elytral intervals; thorax opaque, scabrous, Arizona, 11 mm.....**defecta** Schffr.

The last joint of the antennæ varies with the species as well as sexually, as follows:

| | | |
|---|---|---|
| *pulchella* | ♂ = * preceding | ♀ = * preceding |
| *croceicollis* | ♂ = 5 preceding | ♀ = 3 preceding |
| *liebecki* | ♂ = 6 preceding | ♀ = 4 preceding |
| *subnitida* | ♂ = * preceding | ♀ = 3 preceding |
| *colorata* | ♂ = 3 preceding | ♀ = * preceding |
| *simulans* | ♂ = * preceding | ♀ = 3 preceding |
| *pluripunctata* | ♂ = 4 preceding | ♀ = 3 preceding |
| *resplendens* | ♂ = 5 preceding | ♀ = 3 preceding |
| *robusta* | ♂ = 5 preceding | ♀ = 3 preceding |
| *basalis* | ♂ = 7 preceding | ♀ = 4 preceding |
| *gagatina* | ♂ = 5–6 preceding | ♀ = 3 preceding |
| *opacicollis* | ♂ = 5 preceding | ♀ = 3 preceding |
| *huachucæ* | ♂ = 4 preceding | ♀ = 3 preceding |
| *defecta* | ♂ = 4 preceding | ♀ = 3 preceding |

The extraordinary length of the last antennal joint in *basalis* ♂ is helpful in its identification.

## NOTES AND DESCRIPTIONS.

**Statira gagatina** Melsh.

Mr. Andrew J. Mutchler has called my attention to the original descriptions of Melsheimer, including a described variety overlooked in my catalogue. These are:

*S. resplendens,* yellowish brown, head piceous, thorax yellowish; var.: *fusca,* uniformly yellowish brown;

*S. gagatina,* black, tinged with bluish, glossy.

The word *gagatina* means like asphalt or jet and indicates that what is usually marked *gagatina* in collections is really what Melsheimer called *fusca,* while the rarer form, sometimes marked "*gagatina* var.," with shining black color, is nearer to his *gagatina.* In this connection it may also be recalled that Melsheimer very briefly indicated a variety *viridis* of *Arthromacra ænea* as "green, brilliant, very slender," which has been overlooked in our catalogues. This may be one of the green species I have heretofore described but the few words he used do not tell which, if either.

With *gagatina* in the synopsis I have included a form from Florida, of which I know two specimens, one in my collection and another in Mr. Schaeffer's. These are larger and more slender, and the elytra have apparently only four setigerous punctures on the fifth interval; the elongation of the last antennal joint is, however, very nearly the

same as that seen in *gagatina*. My specimen is a female and not so shining as the male in Mr. Schaeffer's collection, which was collected by Mr. H. L. Dozier at Gainesville.

**Statira liebecki** new species.

Elongate, reddish testaceous, elytra dark bluish-green, shining, with a few setigerous punctures.

Head reddish testaceous, dull with fine close punctulation, sharply constricted at neck; eyes large, black, moderately coarsely granulate; antennæ reddish testaceous, filiform, second joint short, third twice as long as second, succeeding joints gradually shorter except the last, which is as long as six preceding joints in the male, or about four in the female.

Prothorax reddish testaceous, dull with fine close punctulation, longer than wide, rounded at sides, truncate in front, truncate and strongly margined behind. The margin projecting at base forms spiniform hind angles. Elytra shining, dark bluish-green, striate, striæ closely punctate, intervals slightly convex with setigerous punctures on third, fifth, and seventh, principally toward apex. The number of setæ is about four on third interval, one being usually in front of the middle; the total number is about eight, though there are also punctures without setæ on the first interval near apex, and shorter setæ at base of elytra. Body beneath and legs reddish testaceous, abdomen piceous; tibiæ rounded externally. Length, 9.5 mm.

Habitat, Florida and Alabama.

Holotype male, Enterprise, Fla.; allotype female, Spring Hill, Ala., May 15, 1919 (H. P. Loding), both in my collection. Paratype males, Enterprise, Fla., in collections of Charles Liebeck in Philadelphia, American Museum of Natural History in New York, and Staten Island Institute of Arts and Sciences; also one from South Bay, Lake Okechobee, Fla., April 29, collected by William T. Davis, Staten Island, N. Y., and in his collection. Paratype female, Crescent City, Fla., April 24, in the collection of American Museum of Natural History.

This species differs from *S. croceicollis*, also found in Florida, by the paler color of the head and fewer setigerous punctures of the elytra; in *croceicollis* there are from five to seven on the third interval, distributed over the entire length of the elytra, and about four on the fifth interval. It differs from *S. resplendens* by the pale head, paler color beneath, and blue elytra; *resplendens* has piceous elytra and is found in Pennsylvania, Maryland, South Carolina, Kentucky, etc., apparently not extending as far south as Florida.

In reference to the larva of *Statira* there seems to have been but little published, and it may be worth while to quote Dr. Sharp's remarks on the family Lagriidæ (Cambridge Natural History, Insects, part II, p. 264). "The early instars are similar to those of the

Tenebrionidæ, except that the larva is less retiring in its habits and wanders about on foliage; it is of broader form than that of most of the Tenebrionidæ. The pupa has long projections at the sides of the abdominal segments."

## SUPPLEMENTARY NOTES ON OPHIDERMA FAIRM. (HEMIP.–HOMOP.).

BY LEWIS B. WOODRUFF,

NEW YORK CITY.

In 1894 Dr. Goding published a description of a supposedly new species of this genus under the name *flaviguttula,* based upon one female specimen taken in Illinois. A discussion of its status was included in a paper by me in the December 1919 number of the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY (Vol. XXVII, pp. 251–3), in which were listed four specimens of *Ophiderma flaviguttula,* all females, including one in the National Museum determined as such by Dr. Goding himself. In the December 1920 number of that JOURNAL (Vol. XXVIII, p. 214) I cited still another example, taken at Newark, N. J. The foregoing were all so assigned on the basis of the accuracy of determination by its author of the National Museum specimen, notwithstanding the fact that the original description made no reference to the mid-elytral band present in all of them, as well as in my socalled variety *definita,* and in spite of certain other slight inconsistencies pointed out in my paper first cited.

Since those papers were published Dr. Goding has generously presented his type material to the National Museum, and on a recent visit to Washington I availed myself of the opportunity to examine his type of *flaviguttula.* It proves to be a female of *pubescens* Emmons, as suspected by Van Duzee in his "Studies" (Bull. Buffalo Soc. Nat. Hist., 1908, Vol. IX, p. 98). That it should have been redescribed by Dr. Goding is not at all surprising in view of the fact that Emmons's description (Nat. Hist. of N. Y., Vol. V, p. 157) was evidently based upon a male specimen, and that his figure (loc. cit., Pl. 13, Fig. 2—erroneously cited in the text as Fig. 3), while a good representation of that sex of his species, naturally gave no clue to the appearance of

the female, which was doubtless unknown to him. At any rate Dr. Goding apparently regarded Emmons's description of *pubescens* as a redescription of the very similar but larger male of *salamandra* Fairmaire; and finding no description or figure that fitted his female specimen, nor, by reason of his consignment of Emmons's species to synonymy, any recognized male with which to associate it, felt warranted in describing it and giving it a name. Abundant material of both sexes of *salamandra* and *pubescens* are before me, including copulating pairs of each, and there can be no doubt that *flaviguttula* Godg. must fall into the synonymy of *pubescens* Emmons.

This raises my *definita,* which through my misconception of Goding's *flaviguttula* I had described as a variety of that species, to full specific rank. The five specimens referred by me in the above-cited papers to Dr. Goding's species, including not only the one determined by him as such, but the Bronxville specimen described by me under his designation (N. Y. ENT. SOC. JOUR., Vol. XXVII, p. 253), are to be regarded as pale examples of *definita* Woodr.

This species is strongly characterized by the dark mid-elytral band, with more or less bright red and black defining the pattern on posterior half of pronotum. Figures 5 and 6 of plate XXIII accompanying my paper first referred to exhibit respectively the pale and dark forms of this species, figure 5 being that of the Bronxville specimen covered by the detailed description on page 253 of that paper, and figure 6 the designated type of *definita.* In many specimens, too, the normal anteapical vitta, not evidently indicated in the figures, though referred to as obsolete in the description of the Bronxville specimen, appears as clearly defined as are the other markings. The sinuation of dorsal outline shown in figure 6 is individual, and not a specific character.

It should perhaps be noted that while I regarded the prevailing dark form with sharply defined colors and pattern as worthy of a distinctive though varietal name from what I then supposed to be the valid name of the pale form, I do not regard the converse to be true. In this group as a whole the several species frequently exhibit great variation in the amount of their pigmentation; and varietal names based upon that character alone, unless circumstances seem to require them, but add cumbersomeness to the nomenclature. The rather unusual pale forms are simply pale examples of *definita* Woodr.

An interesting specimen of *O. evelyna* Woodr. has come to hand. It is structurally a perfectly normal female; but the color and pattern of its left side, instead of showing the usual unmarked green of that sex, is as in the male—pale yellow; dorsum from about middle to apex light reddish brown, crossed by a broad subapical transverse vitta of the anterior yellow. The right side is wholly normal. Similar masquerading in the colors of the opposite sex has been observed in the allied genera *Cyrtolobus* (including *Atymna* and *Xantholobus*) and *Telamona;* though here one needs to be on one's guard in sex determination because of the frequency of parasitism, and consequent distortion and malformation of the genital organs. This species, *O. evelyna,* proves to be a very common one in our southern states, in Alabama apparently favoring *Quercus coccinea* as its host plant.

## PROCEEDINGS OF THE NEW YORK ENTOMOLOGICAL SOCIETY.

MEETING OF JANUARY 16.

A regular meeting of the New York Entomological Society was held at 8 P.M., on January 16, 1923, President H. B. Weiss in the chair, with twelve members and three visitors present.

On nomination by Mr. Woodruff the following new members were elected:

Walter Everts, 245 West 69th St., New York City.

Dr. Charles A. Leale, 500 Madison Ave., New York City.

Mr. Davis exhibited six boxes of "Tabanid Flies of Staten Island and Long Island" and spoke of the impetus given to his studies by the work of Daecke, Hine, and Dr. Bequaert, as well as of the characteristics of various species of deer flies, horse flies, etc. Also of George Franck's experiences in collecting Tabanids from a tame cow.

Dr. Bequaert said that it was essential to have a really tame cow for the purpose and gave some instances of narrow escapes in Africa from cows that were only apparently tame. He had found a tent closed at one end with mosquito net, a help in collecting, and had obtained many specimens from dark corners on river steamboats. He gave some figures on the number of species thus far known from New Jersey, 82, Staten Island, 46, Long Island, 35, whole world, 2,200, as indicated by Sourcouf's work in Genera Insectorum. He reviewed Enderlein's work on the preliminary classification and that of Marchand and others on the life history. The difficulty of keeping Tabanids in captivity is increased by their exceedingly rapid flight, in which they destroy themselves against the cage. A double cage 20 x 15 feet with walls of mosquito net within the wire gauze had been tried.

Messrs. Davis, Woodruff, and Hallinan discussed the matter further, Tabanid liking for dark places, the biting of the female unpleasantly remembered by all, and their wonderful speed which Mr. Hallinan said he had computed from marked specimens and measured distances at (800?) miles an hour.

Mr. Dickerson spoke on "New Jersey Tingidæ" and especially on recent work by Mr. Weiss and Mr. Barber, with the 28 species known in New Jersey published in circular No. 54 New Jersey Department of Agriculture.

Mr. Davis recalled Mr. Heidemann's interest in these lace wing bugs.

Mr. Woodruff called attention to an insect article in the *Youth's Companion.*

Announcement was made of several matters for Messrs. Decker, Ditmars, and Brady.

### MEETING OF FEBRUARY 6.

A regular meeting of the New York Entomological Society was held at 8 P.M., February 6, 1923, in the American Museum of Natural History, President Harry B. Weiss in the chair, with eleven members and two visitors present. The following new members were elected:

Chas. P. Alexander, Fernald Hall, Amherst, Mass.
A. M. Nadler, 413 Stratford Road, Brooklyn, N. Y.
Ralph B. Lott, Dayton, N. J.
Paul L. Mitchell, 408 Sumner Ave., Brooklyn, N. Y.

on nominations made by Messrs. Notman, Lutz, Weiss, and Davis.

Mr. Woodruff spoke of the coleopterous genus *Polydrusus* Germar, giving its history, definition, and distribution over the world, in part by commercial introduction. The life history of some species was then given and the American species specially considered, leading to the conclusion that specimens found by Mr. Woodruff in Alabama were undescribed.

Mr. Nicolay gave an account of an expedition made by Mr. Quirsfeld and himself as guests of Mr. Notman to Wallface Mt. in the Adirondacks in July, 1922. Among the interesting beetles found were *Elaphrus olivaceus, Sphaeroderus canadensis* and *brevoorti, Nomaretus bilobus, Pterostichus punctatissimus,* etc.

Mr. Notman supplemented his remarks by describing Scott's Pond near which the tents were pitched as being at about 3,000 ft. elevation and near the junction of the Hudsonian or Spruce zone with the Canadian zone of ash and maple trees. A large number of beetles caught by the party were exhibited.

Mr. Nelson spoke at some length on the biological control of certain insect pests, in which he had taken part. The cottony cushion scale at New Orleans in 1916 had been thus controlled by the introduction of Australian lady beetles; the gray scale of citrus in southern California by a small fly. He also spoke of the Argentine Ant in New Orleans marching in single file, 50 feet long, and the control effected by syrup carrying an arsenite weak enough not to kill the ants until after they had carried it to their nests; and of the pink boll worm of cotton introduced from Egypt and controlled only by burning the infected plants. His description also of an insect, possibly a pentatomid, watching over its eggs in Porto Rico developed an interesting discussion.

### MEETING OF FEBRUARY 20.

A regular meeting of the New York Entomological Society was held at 8 P.M., on February 20, 1923, in the American Museum of Natural History, President Harry B. Weiss in the chair, with eleven members present.

Mr. Edgar Nelson, 42 State St., Flushing, N. Y., was nominated for active membership by Mr. Leng.

Mr. Davis spoke with regret of Dr. Bequaert's approaching departure for Africa; he also referred with praise to Mr. J. S. Wade's catalogue of Government Entomological publications.

Mr. Woodruff having taken the chair, Mr. Weiss presented by diagrams the "Money Losses Due to Insects," comparing them with those due to climatic factors and showing the much greater irregularity and importance of the latter. Estimates received from thousands of farmers were used in compiling statistics for a few years past for each important crop; the number of years for which such figures were available was admitted to be insufficient for entirely satisfactory results, but it was maintained that they were more illuminating than some estimates expressed in dollars prepared by theoretical writers. Though some such estimates were quoted Mr. Weiss preferred to use percentages which showed plainly the fluctuating character of climatic damage and the comparatively uniform percentage of loss from insects excepting the recent rapid increase in boll weevil damage, offset to some extent by the advance in price of cotton.

Mr. Weiss having resumed the chair, Mr. Shoemaker exhibited seven boxes of admirably mounted Chrysomelidæ comprising the second half of his collection of 535 species, eight boxes comprising the first half, having been shown on a previous occasion. His personal collecting for 21 years in D. C., in the Catskills, Adirondacks, and on Long Island as well as many additions from Kunze's Arizona material and from exchanges were included. The neat arrangement of the collection as well as the many rarities were greatly admired. Among his 3,909 specimens were large series of *Calligrapha rowena, amelia,* and an apparently new species; a series of *Disonycha discoidea* with one specimen retouched with paint to recall its actual color in life; and there was added the type of *Saperda shoemakeri* to be described by Mr. Davis.

After a general discussion, during which Mr. Davis read abstracts from Mr. Blatchley's letters from South America, Mr. Nicolay spoke of his visits to Washington, and Dr. Sturtevant presented his entomological collections in England, Norway, Sweden, and Holland, to the Museum. The meeting adjourned.

### MEETING OF MARCH 6.

A regular meeting of the New York Entomological Society was held at 8 P.M., on March 6, 1923, in the American Museum of Natural History, President Harry B. Weiss in the chair, with fourteen members and three visitors present.

Mr. Davis spoke of Dr. Bequaert's approaching departure for Africa and the propriety of the Society passing a resolution relating thereto. He read one

he had prepared and on motion by Mr. G. W. J. Angell, seconded by Mr. Woodruff, it was adopted as follows:

"The members of the New York Entomological Society having learned that Dr. Joseph Bequaert is about to depart for Africa for a protracted stay, wish to express their appreciation of the great interest he has taken in the Society since he became a member in 1916, and also of the benefits that have come to it by reason of his learned discourses on a great variety of entomological subjects. It is their hope that his contemplated visit to the Congo River, like those of previous years, will be of value to him, and that with an even greater fund of information, he will ultimately return to America and the meetings of our Society."

Mr. Edgar Nelson, 42 State St., Flushing, N. Y., was elected an active member of the Society.

Dr. A. H. Sturtevant made an address illustrated by blackboard drawings on "The Seminal Receptacles and Accessory Glands of the Diptera" in which he praised the early work of Leon Dufour, 1844, on the internal genital apparatus of the females and the later work of Townsend and Pointely on Tachinidæ before explaining his own discoveries with better optical apparatus than Dufour had. The various types of spermotheca and of ventral receptacles were carefully described and illustrated and, while it was admitted that the relationships discovered could not be used conveniently in a key, yet they threw a great light upon the correct position in classification of some hitherto doubtful forms. Some of these, *Gymnopa* for example, were specially discussed at the close of his remarks.

Mr. Bird expressed his great admiration for the success of Dr. Sturtevant's work on these minute flies and the importance of his findings.

Mr. Nicolay read portions of his forthcoming paper written in conjunction with Mr. Weiss "On the Genus *Brachys* in America" which has been in progress since 1919. He said that eight species and three varieties occurred and that, apart from coloration, the form of the last ventral segment in the female had been found the most useful character. He showed his own and Mr. Leng's collection and stated that the plates had been drawn by Mr. Olsen.

Mr. Mutchler spoke of the recent finding in California of a specimen of *Trachychele opulenta,* within a felled sequoia which from its position must have lived 1,200 years ago. This led to a general discussion of sequoia growing in eastern United States. Mr. Davis mentioned one in Central Park; Mr. Bird one in Delaware 35 feet high; and to the relation of tree ring growth with sun spots.

Mr. Varrelman spoke of Van Duzee's work on beetles and of his own on *Teredo.*

Mr. G. W. J. Angell spoke of his pleasure in meeting his old friends in the Society again.

Mr. Fountain of Exeter, N. H., present as a visitor, spoke of his experiences in bee keeping.

### MEETING OF MARCH 20.

A regular meeting of the New York Entomological Society was held at 8 P.M., on March 20, 1923, in the American Museum of Natural History, President Harry B. Weiss in the chair, with twenty-one members and three visitors present. The Librarian reported accessions.

Mr. Bird read a paper on "Leiby's Recent Work on Polyembryony" illustrated by a Riker Mount showing the image and larva of a species of *Plusia* with 1,732 examples of *Copidosoma truncatellum* which had emerged, all being the development from a single polyembryonic egg.

The paper and remarks are a complimentary resume of R. W. Leiby's publication in Journal of Morphology, Vol. 37, No. 1, on the polyembryonic development of *Copidosoma gelechiæ*.

After an eight years study, that author has brought out an exhaustive cytological treatment of the processes of polyembryony, illustrated by nearly one hundred figures, and it becomes the foremost exposition yet accorded the subject in America.

Attention is called by the speaker to the possible value in the remarkable increase in parasitic, polyembryonic species, and that they may be of much economic moment, if of avail.

Mr. Notman exhibited "Beetles from Sylvan Beach, Lake Oneida" and described the locality as flat, sandy marshes, with a fifty foot wide sandy beach in places. Some unusual captures resulted, enormous quantities of *Dyschirius pallipennis,* and large numbers of *Cicindela hirticollis* and *Omophron tesselatum.* A slow stream flowed into the lake; along its banks *Georyssus* was common and *Omophron americanum* replaced the *tesselatum* of the beach.

Mr. J. C. Bridwell, present as a visitor, gave some interesting notes on Bruchidæ among other items:

*Zabrotes subnitens* on Strawberry blossoms.
*Bruchus musculus* on *Desmodium bracteosum.*
*Bruchus perforatus* on *Astragalus canadensis.*
*Bruchus discoideus* on Bindweed.

He also spoke of the Chrysomelid habit of covering thin, delicate eggs with excrement as a protection from desiccation. *Dibolia,* for instance, bites a hole in plantain leaves and deposits there an egg bearing the family badge of excrement.

Mr. Jones spoke briefly of a recent visit to Bermuda and Mr. Nelson of his intended summer at Mt. Morris, N. Y.

### MEETING OF APRIL 3.

A regular meeting of the New York Entomological Society was held at 8 P.M., on April 3, 1923, in the American Museum of Natural History, President Harry B. Weiss in the chair, with thirteen members present.

The following new members were elected:

Loren B. Smith, Japanese Beetle Laboratory, Riverton, New Jersey.

A. F. Satterthwait, U. S. Entomological Laboratory, Webster Groves, Md.

W. R. Walton, Bureau of Entomology, Washington, D. C.

Wm. O. Ellis, 10 Court St., Arlington, Mass.

Mr. Erdman West, New Jersey Agricultural Department, Trenton, N. J., was proposed by Mr. Weiss.

Mr. Leng spoke of the genus *Statira,* describing the peculiar elongation of the last joint of the antennæ and the elytral sculpture and vestiture that characterize its species. The work of several authors, particularly Dr. Horn and Mr. Schaffer, was mentioned, and finally a new species from Florida discovered by Mr. Chas. Liebeck, of Philadelphia, was exhibited and its differences displayed.

Mr. Davis exhibited Walking Stick insects found on Long Island and Staten Island, especially females of *Manomera blatchleyi* from Illinois and Indiana, with females of var. *atlantica* from this vicinity. Their differences were explained and the curious fact that no males of *atlantica* were known was pointed out.

Mr. Davis also exhibited Cicadas described in the last number of the JOURNAL.

Dr. Sturtevant exhibited a collection of Diptera and Hymenoptera arranged to show many instances of apparent mimicry.

Mr. Notman exhibited the rare butterfly *Erora læta* collected at Keene Valley, N. Y., in various years at dates ranging from May 16th to June 16th.

Mr. Dickerson exhibited a roach pressed between layers of cardboard to show its resemblance to fossil imprints.

Mr. Shoemaker exhibited Tenebrionid larvæ found in the excelsior packing of a box received from Germany.

Dr. Janvrin exhibited a *Cicindela sexguttata* from Teaneck, N. J., collected in May, nearly immaculate and violet in color.

Mr. Mutchler pointed out that while the varietal name *violacea* was at present applied to specimens from Kansas exclusively, it was very unlikely that the types of Fabricius were collected there.

Dr. Lutz spoke of his approaching trip to Paradise Key, Fla., a hummock in the Everglades, where the Cuban Pine and Royal Palm, 60 years old, grew on account of absence of killing frost and where in a reservation of virgin condition, he hoped to obtain some interesting insects.

Mr. Sherman spoke of the high prices obtained for certain natural history books at recent auction sales, averaging at least 25 per cent. more than any previous records. A list of birds by Theodore Roosevelt, which once sold for forty cents, reached the climax by bringing $27.50.

---

**Errata.**—Volume XXXI, p. 156, for *Acer saccharinum* read *Acer saccharum;* for *Quercus primus* read *Quercus prinus.*

**Editorial Notice.**—Because of the increasing cost of publication, the subscription price of the JOURNAL OF THE NEW YORK ENTOMOLOGICAL SOCIETY will be raised to $3.00 beginning with volume XXXII and the custom of giving twenty-five free separates of their papers to authors will be discontinued. Separates will be sold as heretofore, but no order for less than fifty will be accepted.

# Index to Names of Insects and Plants in Volume XXXI.

Generic names begin with a capital letter. New genera, subgenera, species, subspecies, varieties, and *nomina nova* are printed in italics.

# JOURNAL

OF THE

# New York Entomological Society.

Published quarterly by the Society, at Prince and Lemon Streets, Lancaster, Pa., and New York City. All communications relating to the JOURNAL should be sent to the Publication Committee, New York Entomological Society, American Museum of Natural History, New York City; all subscriptions to the Treasurer, Wm. T. Davis, 146 Stuyvesant Place, New Brighton, Staten Is., New York, and all books and pamphlets to the Librarian, Frank E. Watson, American Museum of Natural History, New York City. Terms for subscription, $3.00 per year, strictly in advance. ***Please make all checks, money-orders, or drafts payable to NEW YORK ENTOMOLOGICAL SOCIETY.***

Reprints of papers printed in the JOURNAL will be supplied at the following rates, provided notice is sent to the Publication Committee before the page proof has been corrected:

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 8¢ | for | each | reprint | of | a | 1 | to | 4 | pp. article. |
| 10¢ | " | " | " | " | 5 | " | 8 | " | " |
| 12¢ | " | " | " | " | 9 | " | 12 | " | " |
| 16¢ | " | " | " | " | 13 | " | 16 | " | " |
| 20¢ | " | " | " | " | 17 | " | 20 | " | " |
| 24¢ | " | " | " | " | 21 | " | 24 | " | " |
| 26¢ | " | " | " | " | 25 | " | 28 | " | " |
| 28¢ | " | " | " | " | 29 | " | 32 | " | " |

No order for less than fifty reprints will be accepted.

Two cents additional for each half-tone print. Covers on same paper as the JOURNAL, with printed title page, $1.50 for 50 covers, and 2 cents for each additional cover.

**Authors whose papers are illustrated with text-figures or full-page plates will be required to supply the electrotypes or pay the cost of making the same by the Journal and also to pay the cost of printing full-page plates on coated paper, when advisable, at the rate of about seven dollars per plate. Halftones must be printed on coated paper.**

# THE NEW YORK ENTOMOLOGICAL SOCIETY

Organized June 29, 1892.—Incorporated June 7, 1893.

---

The meetings of the Society are held on the first and third Tuesday of each month (except June, July, August and September) at 8 P. M., in the AMERICAN MUSEUM OF NATURAL HISTORY, 77th Street and Eighth Ave.

Annual dues for Active Members, $3.00.

Members of the Society will please remit their annual dues, payable in January, to the treasurer.

---

## Officers for the Year 1923

*President*, HARRY B. WEISS ..... 19 N. 7th Ave., New Brunswick, N. J.

*Vice-President*, FRANK E. LUTZ ..... American Museum of Natural History, New York.

*Secretary*, CHAS. W. LENG ..... Staten Island Museum, St. George, S. I., N. Y.

*Treasurer*, WM. T. DAVIS ..... 146 Stuyvesant Place, New Brighton, Staten Island, N. Y.

*Librarian*, FRANK E. WATSON ..... American Museum of Natural History, New York.

*Curator*, A. J. MUTCHLER ..... American Museum of Natural History, New York

*EXECUTIVE COMMITTEE*

H. G. BARBER, GEO. P. ENGELHARDT, L. B. WOODRUFF,
JOS. BEQUAERT, G. C. HALL.

*PUBLICATION COMMITTEE.*

J. D. SHERMAN, JR. E. L. DICKERSON, HOWARD NOTMAN,
C. E. OLSEN.

*AUDITING COMMITTEE.*

E. SHOEMAKER, E. L. BELL, A. S. NICOLAY.

*FIELD COMMITTEE.*

A. S. NICOLAY, JOS. BEQUAERT

*DELEGATE TO THE N. Y. ACADEMY OF SCIENCES.*

WILLIAM T. DAVIS.